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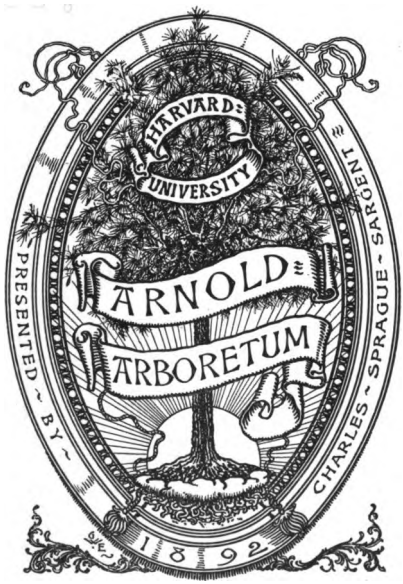

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TRANSACTIONS

OF THE

SCOTTISH ARBORICULTURAL SOCIETY.

EDITOR AND SECRETARY.

JOHN SADLER, F.R.Ph.S.,

LECTURER ON BOTANY IN THE ROYAL HIGH SCHOOL, AND ASSISTANT TO THE PROFESSOR OF BOTANY AND MEDICINE IN THE UNIVERSITY OF EDINBURGH.

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TRANSACTIONS

OF THE

SCOTTISH ARBORICULTURAL SOCIETY.

I. *Address delivered at the Nineteenth Annual Meeting.* By HUGH CLEGHORN, M.D., F.R.S.E., late Conservator of Forests, Madras.

GENTLEMEN,—On taking the chair to which the General Council has called me, my first duty is to thank you for the honour conferred in electing me as President of this Society, an honour which I had little reason to expect, considering that twenty-six years of my life have been spent out of Scotland, and that I am personally unknown to a large proportion of the members. I greatly regret that the notice given to me was so short, that it has not been possible for me to prepare an address suited to the occasion; but I beg to assure you that I will discharge to the best of my ability the duties of my office, and exert myself to promote the interests of the Society.

Eighteen years have elapsed since our association was formed, and though at first its growth was slow, it has been steady. It now embraces in its membership about 600 names, and advances with enlarged prospects of usefulness. The printed Transactions supplied to all our members have reached the seventh volume; these give the best clue to what is being done amongst us. In looking over them for my own information, and for suggestive material in addressing you, I observe a decided improvement in the prize reports; some are very valuable papers, while none are without interest. These records show a wish on the part of many of the members to enlarge their stock of knowledge, and here I may remark, that though we may often go over what appears to be the same ground, we must not relax our exertions as if we had attained to the full extent of knowledge; let us make sure of what we have already acquired, and then

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press on seeking to add our quota towards the stock of mutual help and general information which can only be increased by individual effort.

We who are met together on this occasion are, with few exceptions, practical foresters, and it is as such that I am proud to address you. As foresters loving our calling, we are in constant converse with nature, but we are none the less a busy people, with our hands generally full. We have for the most part as much to do as we can do well, in discharging the routine duties of our position, often more than any ordinary strength or industry can dispatch in a satisfactory manner. We are, therefore, rarely inclined to travel out of the record—to undertake work which does not press. We can seldom get far enough before our duties, or high enough above them to contemplate them *ab extra*, and as a whole, to speculate, classify, consolidate, or systematise. We answer the immediate call; we meet the immediate claim; we provide for the immediate emergency; we are practical men of business, not philosophers; we apply ourselves energetically to understand and transact whatever affair is before us; but we scarcely ever find time to regard questions in their connections and with reference to long eras or to distant generations. What is forced upon us we do; what is not forced upon us we postpone.

This, I take it, is the case of most of those I am addressing. For myself, many of the best years of my life have been spent in the direct charge of very extensive forests, and I can therefore sympathise very keenly with those who feel that the engrossing nature of the duties of to-day interferes with that *foreseeing provision* for the future which distinguishes the profession of a forester more perhaps than any other. Not that I mean to convey that the life of a forester can be lived without thought, and much thought being given to the effect on the future of the labours of to-day; but all must feel that the day's need too frequently overshadows the morrow's requirement, however strongly they may realise that a forester who makes no provision for the wants of the future is unworthy of that title.

And it is in managing forests of small extent, such as many whom I address have charge of, and the property of private individuals, whose circumstances rarely admit of their sacrificing the present to the future, that the truth of my remarks becomes more apparent. Few private individuals can afford to take that higher view of forest conservancy which wishes to make provision for generations

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yet unborn, and fewer still, perhaps, realise the extent of their, so to speak, national responsibilities to maintain the forests which they possess.

It is but three months ago that the newspapers recorded the facts of high floods in England, France, and Italy, accompanied with most serious damage in various places. That these floods, primarily due to excessive rainfall, are aggravated by the more general drainage which the improved agriculture of the present day has introduced, there is no doubt, but it is equally certain that the denudation of the mountain tops has greatly contributed to this result, and with the removal of their verdant clothing, we have to regret not only the washing away of soil from the slopes once covered with forest, but to mourn over homesteads and villages once smiling and now abandoned, and vast areas of richly cultivated land overwhelmed and made barren by the *detritus* of mountain torrents in their now aggravated impetuosity. It is the destruction of forests which has led to this desolation.

How vast is the influence of the forests of a country! They affect the humidity of the air and earth; they influence the temperature; they afford important shelter from the east winds, the *mistral* and the *sirocco;* they create springs, and they tend to control the flow of rivers. The teachings of "savans" (Humboldt, Herschel, and Arago), the records of travels (Marsh, Pallas, and Sandys), the sufferings of nations (Italy, Spain, and Greece), have sadly demonstrated these facts, even in very recent times.

In what way forests arrest the progress of flights of locusts in the East, of coffee-borers and other noxious insects, has now, by careful investigation, been placed beyond doubt; and it is believed by many that they set a limit to malarious vapour, and also to rust spores which infect cereal crops. The productiveness of grain fields is increased by establishing plantations, the health of the cattle is improved, the evil of drifting sand is checked, as for example by planting the *Pinus maritima* on the dunes of France; thus in many ways the material prosperity of a country is bound up with the maintenance of a due proportion of woodland suitably distributed.

During the first stage of colonisation in most countries, as for instance Australia, India, and America, and while settlers are thinly scattered, demands on the wood supply are usually so limited as not to cause undue destruction of indigenous forest, nor to occasion alarm for future requirements. But immigration goes on, agricultural industry is extended, railways are formed, all these causing encroachments on

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the forests to take place, and ultimately denudation follows, with its many attendant evils; and often when it is *too late* the maintenance of forest riches for the first time engages the attention of the legislature.

That such has not been the result in our own country is doubtless due to our insular position, and to our rich resources of mineral fuel. Of the first, and the advantage we thereby possess of being able to draw supplies from all quarters of the globe, nothing short of a convulsion of nature can deprive us; but in regard to the second, the recent disturbance in the labour market may well make us thankful that the time has not yet come when the sinister prognostications of our experts as to the remaining extent of our coal measures have been fulfilled, so far as to oblige us to resort much to vegetable fuel as a substitute. In this connection, I may be permitted to express my conviction that much good may result from the present labour movement in the introduction of coal-cutting machinery, and the consequent diminution of the number of human beings employed under ground, and in the needful economising of the back-bone of our national wealth—*our coal.* And in this last remark, foresters will at once recognise, though indirectly, the importance of their calling. It is where timber is the fuel in use for domestic purposes that the value of the forester's work has come to be most appreciated, and we accordingly find that in foreign countries destitute of coal resources, or backward in their development, the legislature has been compelled to intervene to provide for the maintenance of the forests.

If, then, we would profit to the utmost by the experience of others in this important branch of economics, we must not rest content with a knowledge of the results attained in the narrow sphere presented within our own native land, or of the way in which those results have been reached; most valuable as such knowledge is, the conditions under which it has been accumulated, though diverse, are not sufficiently comprehensive to afford the conclusive data which will be obtained by a study of the matured system of conservancy and reproduction that has grown up in those countries where vast forests are held by the state in trust for the people, and the operations are conducted on a scale commensurate with the interests involved, not only in the immediate present, but in the long distant future.

Bearing in mind what I have already said as to the circumstances which gradually lead to the ultimate denudation of countries, it will be no matter of surprise to you to learn, that in an empire in which we are all deeply interested, which numbers a population of probably

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200,000,000 of people distributed in many parts more thickly than in Lancashire or the country round Glasgow, and in which but few Europeans, and probably not one native have *ever* eaten a meal cooked with coal, a fuel famine has for years been impending. The introduction into India of railways, and the rapidly increased demand for timber for sleepers and fuel, at length forced the attention of the Government to the vital question of forest management.

In the year 1856, when engaged in multifarious duties as a medical practitioner and Professor of Botany in the medical college of Madras, I was unexpectedly called upon to organise a forest service, and to take charge of the forests in south India, a territory three or four times as large as Great Britain. I had had no training in my youth specially to fit me for such a duty; but the need was urgent, and trained foresters were not to be had; if they had been available, the want of the language and ignorance of the habits and products of the country would have rendered them comparatively useless. It is true that at the time I was engaged in teaching botany, to which I had long devoted much attention, and in my youth I had been accustomed to rural life in Scotland, circumstances which were all in my favour. When, with considerable misgivings, I undertook the duty, the natural forests in most parts of the country had been ruthlessly wasted by felling and burning, and no system had been adopted to regulate the cutting, or to provide for the wants of future generations by preserving existing forests or forming new plantations. Magnificent trees were sacrificed for insignificant purposes, and planks were not sawn, but hewn with an axe, one tree furnishing a single plank. The State therefore stepped in to arrest the waste, and to adopt measures for husbanding the resources for present use, and for the supply of posterity. In course of time, after preliminary explorations and valuation surveys, the country was divided into districts, each of them as large, many of them larger, than Perthshire, and placed under the charge of one assistant conservator or forest ranger.

My duties for twelve years necessitated much and rapid travelling in order to become acquainted with the forests over which I had been called to exercise some control. These forests are scattered over a great extent of country, sometimes dotted here and there in small patches, seldom in compact masses. My duties were to ascertain the proprietary rights (if any existed), or rights of pasturage, which wandering tribes possess, to mark out the first class forests to be reserved by Government, to separate the tracts attached to

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villages, to frame leases with native chiefs, to establish and inspect depots for timber, to supply the Indian Navy, the gun-carriage factory, and various public works, and to arrange annual auctions for the general wants of the country.

How different is the experience of foresters in Britain! They are generally engaged, not in the husbanding of state forests, where the good of generations yet to come guides your measures, but in forests belonging to private individuals, where the chief objects are, to meet the current demand for estate purposes, and to yield a good annual revenue. Woodlands in private hands are everywhere managed on the same economical principles as other possessions, and many proprietors will always sell their woods, unless they believe that it is for their pecuniary interest to preserve them.

In no other country of the world is there such careful arboriculture as in Britain; and it is in Scotland that many of the most beautiful and extensive British forest plantations have been formed (such as the famous larch plantations in Blair Athol, superintended by Mr Macgregor). But most valuable as your training has been for the exercise of your calling in Scotland, it can hardly be denied that a training on a more comprehensive system than is possible under the peculiar circumstances of our little island, to which I have already alluded, would be valuable for a larger sphere of action. In this I think you will agree with me, although the conditions of my connection with forest management (to which I am indebted for this opportunity of addressing you) are such as naturally predispose me in some measure to look for guidance, where the conservation of forests has been the result of circumstances similar to those of India, and the management of which has grown up under like conditions.

But should I fail to carry your assent to this opinion, you will, I am assured, bear with me, when I say that, considering the responsibilities placed upon a state forest department, we cannot make too sure that the agents employed in it have the widest opportunities possible of seeing forest operations conducted on a large scale, and that their training is arranged so as to take full advantage of the ripe experience available in those countries in which state forests have long existed, as well as of that skill and experience which is to be found at our own doors.

A main essential in forest operations is economy, and it is on the magnitude of the scale on which operations are conducted that economic results largely depend. The adaptation of means to ends is

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here involved; and though it would be altogether incorrect to say, that what answers on a small scale will not answer, or will answer only in a less degree, on a large scale, there can be little doubt that those who have to administer on a large scale, should first study administration on a large scale; for the results of a mistake which on a small scale may be insignificant, may on a large scale be fatal. It is in this view that the differences between the administration of private forests and of government domains are so marked; and whether we confine our view to the more ordinary operations of forest conservancy and working, including the agency by which timber should be got out of the forest, or embrace within our gaze those allied operations, such as the making of forest surveys, the demarkation of forest tracts, the transport and cutting up of timber, the construction of slides and roads, &c., we must feel that in the matter of the adaptation of means to ends, we should lose much experience if we confined ourselves to the experience available in our private forests, or in any one country whatsoever.

I may mention to you some of the most striking differences that occur to me between the management of Scotch and Indian forests. One great point of difference is, that with many of you, much attention is given to ornamental effect; I, on the contrary, had to do with dark unfrequented forests, where there was often no human eye except that of those employed in forest work. Another difference is, that while our forests are subject to depredations by hares, rabbits, and in some places by deer, the Indian forests are exposed to the rooting up of wild hogs, to the browsing of goats, many of the deer tribe, and above all of camels, whose hard palate, strong teeth and jaws, enable them to break off and masticate thorny branches as thick as the finger. Again, from the vast extent and scattered position of Indian forests, to encircle them with fences, living or dead, is almost a physical impossibility; the usual method of demarcation is by the erection of boundary pillars, between which extends a broad belt of cleared ground. This has to be cleared annually, and is useful for checking the ingress of forest fires, which are of frequent occurrence, and are often productive of serious damage.

The circumstances regarding the carriage of heavy timber in India are peculiar, and the transport is generally effected by means of trained elephants or buffaloes. The former valuable animals are now becoming scarce, and it is for many reasons desirable, if not essential, that foresters for India should acquire some experience

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in moving long and heavy logs over difficult ground, in the formation and use of slides, and in floating timber both in rocky mountain torrents, and in large flowing rivers.

In the Himalayan pine forests, the felling usually takes place in summer, but the slipping and launching of the logs often takes place in October and November when snow is on the ground; consequently there is much that is suggestive for our Himalayan forests in the Swiss and Bavarian Alps. Again, I have no doubt that the timber trade of Norway, and the lumber operations in Canada, where the rafts often contain many hundred thousand cubic feet, would afford much instructive information to those charged with floating operations on our great Indian rivers, as the Irrawady, the Godavery, and the Indus. The floating arrangements in Strathspey, where artificial floods are produced by storing water in a succession of small dams, are very instructive. Most of the youths who have lately gone to India had an opportunity of seeing these operations under the guidance of Mr Grant Thomson, but I know of few forests in India where this identical system of engineering would be found to answer; it would, however, be suggestive to those in similar difficulties. There are various collateral duties falling to foresters in India, which you would scarcely think came within their province. I allude to the preparation of charcoal, and the collection and manufacture of tar and empyreumatic products, which will some day become a matter of great importance in India; further, the collection and manufacture of lac, gums, and resins, as gamboge and kino, the collection of India-rubber, the preparation of potash, and the impregnation of timber by means of antiseptic substances—creosote, chloride of zinc, sulphate of copper, or corrosive sublimate.

At the late meeting in Brighton of the British Association for the Advancement of Science, the grant of L.20 was again renewed, for the purpose of taking observations on the effect of the denudation of timber on the rainfall in North Britain. It is to be hoped that the arrangements for conducting the investigation may be judiciously made and successfully carried out, in correspondence with the energetic secretary of the Meteorological Society.

At the same meeting an instructive paper was read "On the Distribution of Forests in India" by Dr Brandis, Inspector-General of Forests to the Government of India. The writer divides the country into arid, dry, and moist zones, according to the yearly average rainfall in each; and the extent and direction of the several zones were clearly marked out in a coloured map. It was characterised by the

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savans present as a most able and valuable contribution to the physical geography of India, containing truly philosophical views. The paper has appeared in "Ocean Highways," a monthly record of geographical progress. (Oct. 1872, p. 200.)

In England, forest literature has not yet, in my opinion, taken the place which it ought to occupy. In Germany, France, and Italy, there are thousands of volumes and several periodicals, both monthly and quarterly, devoted to sylviculture. There is an annual almanac, giving the names and duties of several hundred forest employés in the service of the state. In these days, when almost every branch of industry starts its own organ, it is not improbable that a Forest Journal may be successfully maintained a few years hence, in which all forest questions could be freely discussed.

I have now, gentlemen, in a cursory way, sketched some of the terrible consequences of neglecting the natural forests of a country, as contrasted with the benefits of careful conservancy. Many of the facts and places alluded to have come under my own observation in the course of duty as a government servant.

I have been favoured with opportunities of visiting the woods of Madeira, the sandy deserts of South Africa, a very large part of British India, the plains of Egypt, the arid island of Malta, classical Sicily, and the rich though sadly denuded shores of Italy. From one and all of these I am ready to acknowledge that I have learned something, both of the difficulties to be overcome and of the success granted to persevering efforts in arboriculture; and were it my lot again to return to India, the remembrance of what I have seen in my various visits to the fine woods of Scotland and the state forests of England, would prove highly useful and instructive.

Every country has its peculiar difficulties, but along with these we see special adaptations to overcome them, and the application of the right means to the end desired is ultimately crowned with success.

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II. *On the Quantity of Rain which falls in a Wooded Country as compared with an Unwooded.* By ROBERT HUTCHISON, Esq. of Carlowrie, F.R.S.E.

The important question of the influence of forests upon the rainfall, the temperature, and the humidity of the air in a country is one so complicated, and demanding for its accurate solution observations both extensive and prolonged, that it need not excite surprise that meteorologists hitherto, although admitting the importance of such an inquiry, have taken no practical step towards the solution of this interesting problem.

From time to time, no doubt, attention has been called to the subject, but only in a casual or very general manner; and the fact remains, that in the United Kingdom, redolent as she is with scientific inquiry, no society or institution has as yet given its direct bent to the question of the effects of either the overplanting or the denudation of timber upon the rainfall of the country, and consequently in an indirect manner upon the health of the community. It is, therefore, satisfactory to know that this Society has undertaken such an inquiry, and that through its exertions we may hope for definite action being taken in this interesting and useful line of investigation.

For several years past, both in France and in Denmark, by the aid of the Academy in the one, and of the Agricultural Institute of Copenhagen, and more recently of the Government itself, in the other, organised and complete systems of careful observations have been going on, and already very interesting facts have been deduced.

To some of the general results of these tabulated observations we shall by-and-bye refer in this paper, with the view of directing the attention of members of this Society to what is being done in other countries regarding a matter of equal importance to our own, and which must prove of deepest interest to themselves individually as practical arboriculturists; and it is but fair to state that much of the subject matter of this paper is translated and collated from the French reports of M. Becquerel, who undertook the inquiry and observations for several years in different parts of the arrondissement of Montargis (department du Loiret), and of M. Lacour Danois, who was in 1869 intrusted with a similar scientific mission by the Government of Denmark.

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We have abundant authority to prove that the belief in the material influences which a *wooded* district exerts upon the rainfall, and in the equally appreciable effects, though in a diametrically opposite direction, which are caused by excessive denudation of woodlands, exists in the minds of philosophers of acknowledged enlightenment in our own country. For example, Sir John Herschel, arguing that to a very great extent the climate of a country is under man's control, states—"It is chiefly in his clearance or allowance of arborescent vegetation, and in his artificial drainage of the soil that his influence is perceptible."* And again, in his report to the Meeting of the British Association in 1865, "On the rainfall of the British Isles,"† Mr Symons asserts that the annual mean rainfall is decreasing appreciably upon an average of nearly 4 per cent. over the whole area of the country, but especially along a tract of land extending from Cornwall to the Wash; and this deficiency he attributes partly to the extensive clearances of timber, and partly also to the divergence of the flow of the springs by ground drainage, now considered so necessary for the high-farming of the present day, by the advanced agricultural knowledge of the period.

If then it be true, that the overfelling of timber and the excessive drainage of our fields tend to diminish the rainfall, and if a certain quantity of rain at certain seasons be requisite to maintain the equilibrium of healthy climate, and to prevent the recurrence of periodic droughts, and short crops, whether root or cereal, it is then clearly essential that there should be an adequate extent of wooded surface properly distributed over the area of the country. The main questions then come to be, Is it true? And next, What would, for Great Britain, be an adequate and properly distributed acreage of woodland?

As, however, it may be held that as yet the proposition is not proved to be true that in this country the presence of a certain counterbalancing proportion of plantation is requisite to maintain a certain proportion of rainfall over the whole area, it may be as well to defer meanwhile following out this branch of the subject in detail, and we shall, therefore, at present only remark, that taking the total acreage of Great Britain at 57,000,000 acres, of which probably about 2,600,000 are under plantation and woodland, or barely $1\frac{1}{2}$ per cent. we find an amount which, if we except the relative proportion of wooded lands in Portugal, is considerably under that

* Familiar Lectures on Scientific Subjects. Weather and Weather Prophets.

† Proceedings of British Association, 1865.

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of any other country! If we even assume the calculation of Col. Sir Henry James, R.E., chief of the Ordnance Survey Department, who estimates that in England alone the proportion of wooded area is equal to 2½ per cent., we still find a considerable deficiency as compared with similiar areas of other countries, with the one exception already noticed. Thus we find—

Country.	Total Areas.	Wooded lands Areas.	Percentage under Wood.
France,	129,216,000 imp. acres	21,966,720 acres	or 17 per cent.
Germany,	135,738,240 acres	*	*
Austria,	144,799,840 acres	15,850,837 acres	or 11 per cent.
Denmark,	6,849,812 Dan. töndes	319,102 Dan. töndes	or 6·61 per cent.

Therefore it appears that the importance of the subject now under consideration has forced itself upon State notice; and in many countries of the continent,—as, for example, in Germany, France, Hanover, and now also in Italy,—as it is well known, schools of forestry exist, and laws are rigidly enforced in relation to the conservancy of woods. Large tracts of fertile acres, producing the finest cereal crops in the world, now flourish in Hungary, where formerly arid sterility prevailed. This has been brought about by the judicious distribution of plantations in zones, and in large masses in the district of the Vosges; and even in our own Indian empire, so important is it now deemed to conserve the forests of the different provinces, that it forms a separate department of imperial control; and, according to the words of the present Under Secretary of State for India (Mr Grant Duff), "had we known thirty years ago what the importance of forest conservancy is for India, L.30,000 per annum, now requisite for irrigation, would have been saved to the Indian exchequer;" and we may be permitted to add, much of the misery and starvation caused by periodical rice famines would have been avoided. The soil of the Himalayas is very similar to that of a great part of the area of Scotland. The difference consists in climate chiefly, and if the proper distribution of wood and its conservancy can modify and ameliorate the fickle climate of a large portion of India, or at least is considered conducive to such bene-

* Owing to the recent amalgamation of the German Empire these figures cannot yet be quoted.

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ficial results, why should steps be neglected at home, or investigations as to the efficacy and value of such steps be overlooked? There are many tracts of land in Scotland which might be advantageously planted up, and thereby, we cannot doubt, the capricious rainfall be modified, and surrounding pastures and fields at higher altitudes brought under the ploughshare. Doubtless in this respect much, very much, has been already done, but still there remains a considerable amount to reclaim, and an undue severity of climate to improve, in many districts. Why is it that at the present day, in Lanarkshire and Peeblesshire, and in other counties also at elevations of 800 and 1200 feet above sea-level, noble specimens of many of the recently introduced *Abies Douglasii* are to be seen? It is entirely due to previous judiciously arranged plantations, having so ameliorated the soil and climate that, interspersed with the native fir or hardy spruce, we now see the Douglas pine vieing with them in luxuriance. And if planting be so important, and plays so prominent a part in those respects we have alluded to, we hold it to be no less essential for the due distribution of rainfall throughout the country, for to a great extent it is regulated by such local influences. But assuming, then, that for climatic purposes, a due balance of acreage under wood is to be maintained in any country, how is the precise amount of land to be so occupied to be ascertained? This is a very difficult question to solve, and one requiring much careful analysis of the separate individual requirements of different countries and their capabilities. For instance, in one country, whose necessity for wood as its staple of fuel, and whose consumption of such may be an increasing one—as, for example, in Russia—a much larger area would be requisite, unless indeed rapid-growing trees were planted as crop, and felled as they advanced in blocks from year to year. Of course, the larger the body of land the greater would be the amount essential for hygienic purposes, or climatic balance. And again, the other necessities of the economy of the country must be looked to, such as the area for food-producing or flesh-growing crops. Germany, for example, we find requires fully 20 per cent. for agricultural purposes; France in 1868 had 17 per cent. under wood, and for her own requirements this was found much too small a proportion of plantation. To provide for equal rainfall distribution, therefore, the mode that appears most feasible and at the same time consistent (if it is found after sufficient investigation, that a standing area of woodland is essential to the welfare of any country), is for the Government, as in the case of

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India, to take the necessary acreage of State forest-land under its control, and to set it apart for the purpose. Were such a plan followed out in England, a Government school of forestry might thus easily be established, and young men trained there for service in the Indian or other colonial forests, instead of, as at present, being under the necessity of sending aspirants to Indian forest vacancies abroad to the schools of Germany or France. If such an establishment be found beneficial for the education of the youth of this country (specially for the Indian *civil* service), as Cooper's Hill College, in London, why should not some similar establishment be organised for the Indian forestry department? This is, however, apart from the immediate subject before us, and to return from such a digression, we may remark, *a propos* of the necessary quantity of land required for plantations properly distributed over the area of the country with a view to equal distribution of the rainfall, that the present condition of England may safely be assumed as a basis, and her present supply of woodland as at least a fair normal one; and since we find that, as there are estimated to be in England 2,600,000 acres under wood, against a total of 57,000,000 acres, it follows that we may assume 1 acre in 22 as a fair requisite proportion for shelter, health, and climate.

Having thus far noticed the general aspect of importance which the subject presents, and passing over, in the meantime, the burden of proof that trees and plantations *do* exert those influences upon the rainfall of a country, which it has been asserted pertain to their presence or absence, we may take up the question, what *does* influence the rainfall of a country?

So numerous are the causes which lend their influences to affect, for increase or decrease, the quantity of rain that falls over any large surface, such as the area of a country, that it is very difficult to state one *a priori*. Even if we were in possession of an accumulated mass of facts and statistical observations extending over several years, such as have been collected in France and Denmark, we should find that many purely local or casual circumstances intervene to throw doubts upon the results deduced from even the most carefully ascertained hygrometric observations. Taken in the abstract, however, we may mention what we consider the four *primary* elements at work in increasing or diminishing rainfall generally:—1. Atmospheric pressure; 2. Neighbourhood of the sea; 3. Prevailing winds, according as these are dry or moist; and, 4. Altitude. But while these all act more or less powerfully

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according to circumstances in producing rainfall, there must always be others, which, although entirely local, and probably therefore more difficult to define or specify, are nevertheless of considerable potency in their agency, and these must be known before we can determine the climate of any locality with regard to humidity. In fact, curious and conflicting discrepancies may ffequently be observed between the quantity of rain which falls in two situations proximately situated to each other, and at the same altitude, at the same distance from the sea, and exposed to the same wind, which will then force upon us the undeniable conclusion that the variation is due to *local* shelter, or from the one situation being exposed (while the other is not) to moist winds, being situated on a height, or in a valley. We may here mention a fact which has been frequently observed. When the clouds, wind-driven, and careering along at no great elevation above the earth's surface, approach or encounter a mountain, or sometimes even a small hill only, they are seen perhaps to rise, and attaining thus to a colder stratum of air, they become condensed into rain; and may we not, therefore, believe that forests or plantations of timber, when the clouds are very low, produce the same results, varying probably with the seasons? Of course, any such influence will be intensified, and rendered the more sensitive, in proportion to the area of the plantation or forest, and as the masses of woodland are more or less considerable. Upon this point, however, until the contemplated hygrometric observations from a variety of stations under suitable conditions have been obtained and tabulated, it is impossible to speak with anything like certainty; and it is just one of those many interesting points which, apart from all theory or preconceived notions on the subject, it is desirable to settle conclusively if practicable, and that can only be done in any complicated problem or dark unsolved mystery, by applying to it the lantern of experiment and careful observation. This necessitates the establishment in different parts of the country of observatories, in each of which daily records must be made of the temperature of the air and of the sun, as well as of the quantity of water which falls *under woods*, on the margins of the same plantations, and at distances more or less remote from these woods. For a society like the Scottish Arboricultural Society, it may be perhaps better, at first, at all events, to confine the registers of its observers only to the rain-gauges in these situations, leaving those concerning the thermometers, *as optional at present*, upon those willing to undertake their registration.

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Something of this description has been undertaken several years ago in France by M. Becquerel, who in 1868 had established, with the help of the academy, five observatories in different parts of the arrondissement of Montargis (department du Loiret), in each of which daily observations have been made since the month of July 1868, until, we presume, the ill-omened recent Franco-German war put a stop to all such peaceful study. The results of these observations, however, we are unfortunately unable at present to communicate in this paper. They will, however, be obtained and published at a future opportunity.

In Denmark also, the Agricultural Institute of Copenhagen have obtained similar observations, taken at fourteen different stations in the interior, near forests, and at a distance from them; and more recently, in 1868, M. Lacour Danois was entrusted with a similar and more minute scientific mission by the Danish Government. The results arrived at by the various observations contained in the tables annexed to his report are briefly as follows :—

The localities in which the observations were made form two distinct groups,—the first, in Jutland; the second, in Zeeland. The one consists of ten observatories, the other of four. The observations were first commenced in September 1862, and were continued till 1869. Their discussion has shown that the quantities of water which fell at 9 leagues and at 2 leagues, differ from each other from 243 to 129 millimetres; whilst in other localities, in the middle of the forests, on the outskirts, at 5 leagues distant, and in an unwooded country, the differences do not exceed above 30 millimetres. Similar results were obtained from the Zeeland groups of observatories, with regard to the quantity of rain which fell in forests, and 2 leagues distant. These are differences too small to justify us in concluding that in Denmark more rain falls by reason of forests than at a distance from them. In inquiring whether the seasons do not influence the distribution of rain, it has been ascertained that, generally speaking, the rainfall of summer and autumn is nearly double that of winter and spring. Denmark is in the region in which the summer rains are prolonged into autumn; we have besides discovered this fact which is not without interest, that in six localities there falls a little more rain in summer and in autumn than in winter and spring in the middle of the forests and on their borders than at a distance of from 2 to 5 leagues distant. In other localities the reverse is found to be the case. Ought this fact to be attributed to local causes? It is impossible to tell. The observa-

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tions made bring out distinctly the facts above related. We may, however, remark that Denmark, being situated between two seas—the ocean and the Baltic—possesses a very damp climate, which, of course, renders local influences less powerful.

Passing now to the observations made in five localities in the department du Loiret, from August 1865 to April 1868, in a circle of about 20 kilometres (12½ miles), in the middle of woods, under trees, on the outskirts, and in unwooded positions; and upon a comparison of these with similar registers taken at Paris, it is found that in a space of eight months, one-fourth more rain fell in wooded than in unwooded localities. But whether or not this is an infallible fact, it is premature as yet to assert from the absence of a sufficient number and variety of observations.

M. Becquerel also compared the quantities of rain which fell in places shaded by trees with what fell in places outside the woods, in order to ascertain how much water was retained by the branches, according as they were or were not in leaf, and he proved the following fact, which of course was to have been expected, that the portion retained by the branches is greater in proportion as the rain is less heavy. When the branches are in full foliage, there was 0·47 of the quantity of water which falls in an unwooded plain so retained, while it is about one-half of that quantity in winter, the effect varying according as the leaves are more or less shaken by the wind. "What then becomes," he asks, "of the water retained by the branches and leaves?" and answers his query, as follows:—"It is probable that the portion which escapes evaporation descends by the trunk and the roots into the soil and subsoil, where it supplies the lower springs." Without venturing upon more definite statistical data, for want of a sufficient number of observations, in 1868, M. Becquerel came to the fair conclusion that, throughout the arrondissement du Loiret more rain falls in wooded than in unwooded districts, a conclusion which, there is little doubt, will be amply verified by his subsequent collection of observations, under the same conditions, not only in the same department, but also in different parts of France and abroad. These observations he contemplated combining with others on temperature, from researches conducted by means of instruments for determining the degree of humidity in the air above trees and under them. What these researches have resulted in, we shall be obliged, from the length of this paper, to delay to another occasion.

Suffice it to say, that all such undertakings, however initiatory

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even, are laudable in themselves; and with a mass of such accurate details as this indefatigable Frenchman has so interestingly collected and recorded, and with his observations to aid in guiding us to similar researches in the wooded districts of Scotland, useful documents may be obtained for the solution of the important question of the influence of forests and trees upon the rainfall, the temperature, and the humidity of the air in a country.

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III. *Report on an Arboretum at Cluny Castle, Aberdeenshire.*

By WILLIAM GILCHRIST, Forester.

The premium offered by Messrs Lawson and Sons being for a "Report on the most extensive, complete, and judiciously arranged Arboretum," it is well to state at the outset that the arboretum at Cluny Castle cannot lay claim to the two first requirements, and the third is partly a matter of taste guided by local circumstances. However, as it contains upwards of 360 varieties of ornamental trees and shrubs, I submit a report thereon. It consists of two detached divisions; in the one, the plants are grown singly, to promote and exhibit their ornamental capabilities; in the other, most of the same species are mingled with ordinary forest plants, so that their value as timber-producing trees may be compared with the varieties now in general use when grown under the same circumstances. The planting of both divisions was begun in the spring of 1868, and the principal plants were planted in the spring of 1869; but as the results are already somewhat different, it will be better to note each division separately.

1. The division containing the ornamental specimens may be described as a belt about 400 yards long, with an average breadth of 21 yards, in the form of an easy reversing curve, exposed to the south-east, and sheltered on the north-west by an almost parallel belt of hardwood trees. The elevation is from 280 to 350 feet above sea-level, as per Ordnance Survey. The soil is a light brown loam, and the subsoil gravelly, of variable depth. In some parts it is very hard, and almost impenetrable at from 12 to 15 inches from the surface. Previous to being planted, it was old pasture land with a rough foggage. There are a few old stone drains; but as the ground has a rather steep declivity to the south and south-east, and shows no symptoms of undue wetness, it was not thought necessary to put in more drains. In December 1867, the ground was trenched from 15 to 18 inches deep, at a cost of about L.11, 10s. per acre, and a few of the specimen trees planted without any particular arrangement. During the early spring of 1869 all the plants were replanted, and arranged in the following order:—

A gravel walk, 4½ feet wide with grass borders, runs through the centre, and on each side of the walk there are three parallel lines. The first line is on the south-east or outside, and consists of deciduous shrubs; the second line, of coniferous trees and shrubs alternately; the third line, next to the walk, of dwarf evergreen

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shrubs; the fourth line, on the other side of the walk, is similar to the third, and the fifth line to the second. The sixth line is composed of hollies, hawthorns, and some of the newer varieties of dwarf-growing deciduous trees. A portion near to the centre being broader than the average, the fifth and sixth parallel lines are slightly deviated from. Between the parallel lines and the hard-wood belt on the north-east side is a strip of mixed trees and shrubs planted closer than the others, to form a background and screen from the old belt.

In the parallel lines the plants are 15 feet apart, and generally single specimens, except some of the smaller varieties, which are in groups of three or four plants. The whole are arranged so that the shrubs and dwarf varieties may be grown as underwood, and the larger varieties allowed sufficient space for development.

The first or outside line contains specimens of *Berberis Darwinii, dulcis,* and *vulgaris; Cornus* (dogwood) *alba, mascula, variegata, sanguinea; Cotoneaster Simonsii; Deutzia corymbosa* and *scabra; Genista,* varieties; *Hippophae rhamnoides* (buckthorn) and *salicifolia; Leycesteria formosa; Lonicera xylosteum,* and *tartarica; Philadelphus coronarius, grandiflorus, latifolius, nanus, verrucosus,* and *Zeyheri; Potentilla fruticosa, Ribes aureum, Menziesii, sanguineum, atro-sanguineum,* and *flore albo; Spiræa adiantifolia, ariæfolia, callosa, corymbosa, Douglasii, Foxii,* and *opulifolia; Symphoricarpus occidentalis* and *racemosus; Syringa Josikæa, persica, alba, Charlemagne, Charles X., grandiflora, Triomphe d'Orleans,* and *Prince Nottiger; Viburnum Opulus, rosea,* and *sterilis,* double Guelder rose.

The second and fifth lines and the broad portion in the centre are composed of specimens of *Abies Albertiana, canadensis, Douglasii, excelsa, firma, inverta, monstrosa, pendula, Menziesii, orientalis, Smithiana; Araucaria imbricata; Biota orientalis; Cedrus atlantica, Deodara* and *Libani; Cupressus Lawsoniana, stricta, macrocarpa,* and *nutkaensis; Juniperus chinensis, hibernica,* and *recurva; Picea amabilis, bracteata, Cephalonica, Fraseri, grandis, lasiocarpa, magnifica, nobilis, Nordmanniana, Pichta, Pinsapo; Pinus austriaca, Benthamiana, Cembra, excelsa, Laricio,* and *ponderosa; Retinospora obtusa,* and *pisifera; Wellingtonia gigantea* and *variegata; Taxus fastigiata* and *Nidpathensis; Thuja gigantea, Lobii, occidentalis,* and *Warreana.*

In the third and fourth line on each side of the walk are *Abies clanbrasiliana; Biota aurea* and *elegantissima; Cephalotaxus*

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drupacea; Cryptomeria japonica and *Lobbii; Juniperus canadensis, caucausica, rigida, drupacea, excelsa, excelsa stricta, argentea; Retinospora filifera, plumosa,* and *squarrosa; Sequoia sempervirens; Taxus elegantissima,* variegated silver and golden; *Alaternus,* two varieties, green-leaved and variegated; *Arbutus,* several varieties; *Aucuba japonica,* male and female; *Azalea,* six varieties; *Buxus* (boxwood), several varieties not named; *Daphne Laureola, Mezereum, atropurpureum* and *alba; Ilex,* variegated hollies, twelve varieties; *Laurestinus,* varieties; *Ligustrum japonicum* and *ovalifolium; Mahonia aquifolia* and *japonica; Pernettya floribunda* and *mucronata; Tamarix gallica; Rhododendron* (hybrid), twelve varieties. Besides these, it is intended to introduce 100 named varieties of rhododendrons during the incoming season.

In the sixth line are specimens of *Acer Negundo, rubrum* and *stricta; Betula asplenifolia, laciniata, pendula* and *populifolia,* varieties of double-flowering cherries; *Cratægus* (flowering thorns), varieties, including *coccinea, Douglasii, latifolia, Macnabiana,* and *odoratissima,* Paul's new double crimson, *reginæ pendulæ purpurea,* single and double scarlet, double pink and white. These are planted alternately with varieties of hollies, including *Ilex angustifolium,* blotch-leaved, *Dowingtonense,* Dutch, *Hodgensii,* hedgehog, *hybridum, latifolium, laurifolia, myrtifolium, nobilis, regina* (Queen), gold and silver, *serratifolia, pictum, tricolor, Scotica,* yellow-berried, &c.; *Quercus austriacus, Fordii* and *Lucombi.* In the strip of mixed trees and shrubs between the sixth parallel line and the belt of hardwood trees are, *Acer campestre, austriacum, circinatum, colchicum, Douglasii, eriocarpum, Leopoldii, macrophyllum, monspessulanum, Neapolitana, opalifolium, pensylvanicum, Pseudo-Platanus, burettia, purpurea, albo-variegata, Corstorphine, saccharinum, tartaricum; Æsculus* (horse-chestnut) *Hippocastanum coccinea, flore pleno, rubra, spectabilis* and *rubicunda; Alnus americana, cordifolia, glutinosa, asplenifolia, Hudsonica, incana, orientalis, ovata, serrulata,* &c.; *Amygdalis* (almond) *dulcis, pedunculata, persica flore pleno* and *alba; Betula* (birch), several varieties; *Carpinus* (horn-beam) *americana, betulus, heterophylla* and *incisa; Carya* (hickory tree) *alba* and *amara; Castanea* (chestnut) *Americana, vesca, asplenifolia, cochleata* and *crispa variegata; Cytisus* (laburnum), several varieties; *Fagus* (beech) *asplenifolia, cristata, pendula, purpurea,* &c.; *Fraxinus* (ash) *Caroliniana, aurea, aucubæfolia, integrifolia, nigra, sambucifolia; Juglans* (walnut); *Liriodendron tulipifera; Mespilus* (medlar); *Morus*

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(mulberry) *nigra* and *rubra; Platanus* (plane) *nepalensis, acerifolia, occidentalis, orientalis,* &c.; *Populus* (poplar) *alba,* new variety, *Abele, balsamifera, canadensis, canescens, cordata, Caroliniana, dilatata, Lindleyana, nivea, tremula, pannonica,* &c.; *Pyrus,* several varieties not named; *Rhamnus catharticus* and *frangula; Salix acuminata, alba, pendula,* and new silvery, *amularis, argentea, Babylonica, caprea,* Kilmarnock and American weeping, *pentandra,* golden, Huntingdon, Bedford, &c.; *Sambucus* (elder), scarlet-fruited and other varieties; *Tilia* (lime) *alba, europœa, asplenifolia, grandifolia,* &c.; *Ulmus* (elm) *crispa, fastigiata, gigantea, purpurea,* Camperdown, weeping, *pendula,* &c. Besides these, there are common and Portugal laurels, Scots yews (varieties), hollies of sorts, *Pinus montana* and *maritima,* and other forest trees, as also small plants of the commoner coniferous trees and shrubs, mentioned as being in the parallel lines.

These trees are planted too close to remain permanently, but they are regularly root-pruned, so that they can be removed at any time, the chief object being to test the hardiness and suitableness of the different sorts for the district, and to have specimens of as many varieties as possible, so that they may be permanently planted in suitable places when their individual characters are known. A number of the hardier varieties have already been removed, and others substituted in their places. Some of the willows and poplars are not expected to become large trees, as the situation is not suitable; but some of the specimens are so interesting that it is thought desirable to grow them for a time for reference and as a contrast with the other varieties.

There are two small rockeries (one at each end), and growing in these and on a stone wall adjoining are varieties of ivy, lonicera, brambles, briars, &c.

As the planting has been done at different periods, the exact cost cannot be stated, except for the spring of 1869, when the division was laid out and the plants arranged. During that season the wages for work in connection with planting, &c., amounted to L.38, 10s.; and during each season since there has been about L.4, 15s. expended (exclusive of cleaning) in root-pruning, replanting, &c. The original cost of the plants is shown in the annexed table.

The result of the planting of this division in 1869 may be said to have been a complete success, as only one of the conifers (*Abies Smithiana*) was lost. A few of the deciduous plants went back,

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but have sprung again from the root. During the first winter most of the doubtful varieties were protected from frost by spruce branches, and each succeeding winter the small tender plants have been protected by the same means. In the spring of 1871, *Picea Pichta* was slightly frosted, and *P. Pinsapo* and *cephalonica* lost their leaders from the same cause, but they have again got leading tops. The late frosts this spring (1872) slightly affected some of the larger varieties, including *Picea nobilis, glauca,* but the damage has not been followed by serious results. Two of the best *P. nobilis* had 14 inches broken off their main leaders in the month of July last, when they were in full vigour, and the young shoots in a brittle state. Heavy birds alighting on the tops were supposed to be the cause, and to prevent this occurring to any of the others, small wood stakes were attached to the main stems, reaching above the tops, so that birds might alight on the stakes and not on the tops. No similar accidents have occurred since.

Some of the *Cedrus Deodara* and *Libani* were overgrown and bushy before planting, and required severe pruning before leaders could be procured, but with these exceptions, and the removal of double leaders and foreshortening with the finger and thumb of extraneous lateral shoots when in a young and soft state, these plants have received no other treatment.

II. The second division is about 500 yards to the west of that already described. The form is triangular, containing about 3½ acres. Elevation, soil, and subsoil similar to No. 1. Exposure to the west and north-west; sheltered from the south-east. Previous to planting, it was old pasture; but it was deep-ploughed and thoroughly harrowed before being planted in the spring of 1868 with a mixture of ordinary forest trees at about 3½ feet apart. The plants and planting cost about L.6, 10s. per acre. The ornamental trees, to which I shall refer, were planted in the spring of 1869, their introduction being an afterthought, consequent on the planting of division No. 1, the object being to test them along with the ordinary forest trees.

It would be useless to enumerate all the plants in this division, as, with the exception of some of the newer and rarer sorts, most of the varieties planted in No. 1 occur also in No. 2, with the addition of *Pinus Jeffreyii, monticola, Murrayana, Pallasiana,* and *pyrenaica.* The shrubs and dwarf varieties are arranged on the south-west side (parallel to which a carriage-drive passes), and the taller varieties to the background. The coniferous trees are planted

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at 30 feet apart, and the principal hardwood trees in the centres. For the first two years the ground was kept regularly cleaned, but for the last two years only about eight yards in width, next to the carriage-drive, has been dressed, the plants being closely met on the rest of the ground.

The ordinary hardwood trees, as also the spruce, larch, and Scots fir, are making rapid growth; but it will be seen from the annexed table that some of the ornamental varieties are doing better, especially *Picea grandis* and *nobilis*, *Abies Douglasii* and *Menziesii*. The true pines were all very small when planted, but they are also doing well, particularly the Austrian, Corsican, *ponderosa*, and *pyrenaica*. Some of the Wellingtonias had the points of their lateral shoots frosted on the 8th of October, and less slightly, *Abies Menziesii* and *Smithiana*, *Picea nobilis* and *magnifica*. Some of the Acers were also slightly touched, but no trees appear to be materially damaged, except the Wellingtonias; however they may soon regain their appearance, as the tops are not affected. At the same period none of the plants in the other division were the least injured. The whole of the shrubs along the side of the carriage-drive, although fully exposed, are doing remarkably well; but being chiefly the same varieties as in the other division, the names are not repeated in the table, as it is only for the timber-producing trees that this division is noticed.

It will be seen from the table that the coniferous trees in this division are making greater top growths than in No. 1, but less laterals or spread of branches. No doubt this is owing to the confinement, but as they are all taking girth of stem along with top growths it will be interesting to compare and note progress. In the meantime, it is well to keep in view that in No. 1 the plants were much larger when planted, and all selected; while in No. 2 they were much smaller, and not particularly selected. The column stating the cost of plants shows a great difference in original prices.

All the trees in both divisions were planted by pitting in the usual manner, without manures or artificial stimulants of any kind. Owing to the ground having been trenched or ploughed, the rough turf was generally brought to the surface in making the pits, but it was carefully chopped up before being put into the pits again. As a matter of course, the best of the soil was put next to the roots of the plants, and great care was taken to place the roots at the proper depth and as naturally as possible.

The names of the coniferous plants in No. 1 division are shown

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in enamelled letters on "Maw's terra-cotta labels," suspended by galvanised wire stakes in front of each plant. The names of the others are written on zinc labels, with a preparation sold for the purpose, and the labels are, as a rule, attached to one of the branches of each plant by copper wire.

Seeing that this "arboretum" has been recently formed, and that new varieties are being constantly added, it would be premature to state how the different sorts of plants are likely to succeed. However, the annexed tables give a comparative view of their progress, and affords some criterion as to the prospects of future success :—

Note.—Since the above was written the following sorts have been added to the collection .—*Abies Englemanii*, *Biota semperaurescens*, *Cephalotaxus Fortunei*, *Juniperus filicoides*, *Sabina*, *Schottii*, *virginiana*, *glauca*; *Taxus adpressa*, *glauca*, *Dovastonii*, *erecta*, *ericoides*, and others; *Thuja occidentalis*, *pendula*; *Arbutus*, 12 named sorts; *Buxus pendula*, *variegata*, and 6 named sorts; *Berberis Belstaniana*, *Jamiesonii*, *empetrifolia*; *Cerasus Azoricus*, and *myrtifolia*, *Corylus*, 14 sorts named; *Quercus coccinea*, *Rubus leucodermis*, &c.

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TABULATED STATEMENT OF PLANTS IN ARBORETUM AT CLUNY CASTLE.

Names of Plants.	Year when Planted.	Cost.	Annual Growth of Division No. I.				Annual Growth of Division No. II.				Present Height.		Girth at Surface.		Spread of Branches.		Age.	Remarks.
			1869	1870	1871	1872	1869	1870	1871	1872								
CONIFEROUS ORNAMENTAL TREES AND SHRUBS.			In.	In.	In.	In.	In.	In.	In.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Years.	
Abies alba	1869	1/	4	12	16	16	...	...	...	...	6	3	0	6½	4	0	11	Thriving plant, but only grown here for variety.
Albertiana	1869	5/	7	20	34	33	...	...	...	...	11	6	0	11	10	0	12	Both graceful, and growing remarkably well.
do.	1869	5/	10	18	34	36	...	...	...	...	12	3	1	3	9	0	12	
do.	1869	3/6	...	...	...	...	8	14	20	18	8	6	0	8	6	0	10	Not so graceful, chiefly owing to the confinement.
Canadensis	1869	/6	3	7	8	8	...	...	...	...	3	0	0	6	5	6	10	Inclined to be shrubby; best specimen in No. II. Division.
do.	1869	/6	...	...	...	...	4	8	10	12	3	6	0	6	5	6	10	
Douglasii	1869	10/6	6	18	30	30	...	...	...	...	11	0	1	2	10	0	12	These are not so dark green as some others, and appear to be a different variety.
do.	1869	4/	7	18	20	21	...	...	...	...	10	0	1	3	9	0	10	
do.	1869	4/	10	20	8	24	...	...	...	...	9	6	1	0	7	6	10	Transplanted in 1871, and is bearing cones this season.
do.	1869	1/	8	12	24	24	...	...	...	...	8	6	1	0	8	0	9	Dark green, and glaucous in appearance.
do.	1869	1/	...	...	...	..	6	16	30	42	9	9	0	11½	8	0	9	
excelsa	1869	/3	6	12	10	10	...	...	...	...	6	0	0	6½	5	0	10	Both plants look well, but that in Division No. I. promises to be the most ornamental.
do.	1869	{ 1/6 p. 100 }	...	...	...	...	4	8	12	15	4	3	0	5	3	6	9	
inverta	1869	21/	6	9	8	4	...	...	...	...	9	6	0	6½	2	6	15	Said to be the two best specimens in Scotland.
do.	1869	21/	5	11	9	5	...	..	...	...	11	0	0	8	3	0	15	
do.	1869	3/6	...	...	...	...	4	12	6	9	7	0	0	6	2	0	10	Not so graceful as the two former, but apparently more healthy.
monstrosa	1872	3/6	...	...	...	6	...	...	...	...	2	6	0	4½	2	6	6	A good contrast, but not considered ornamental.
do.	1872	3/6	...	...	...	...	...	...	...	7	2	7	0	4½	2	6	6	
nigra (Blk. American)	1869	1/	4	18	8	8	...	...	...	...	5	6	0	6½	3	0	11	Growing in the shade; soil apparently too dry.
do. do.	1869	1/	...	...	...	...	4	16	14	14	6	0	0	6½	3	0	11	Much healthier in appearance than the former.
firma	1869	5/	2	8	10	5	...	...	...	...	3	5	0	8	2	0	12	Not looking so well as some of the others.
Menziesii	1869	7/6	12	24	44	40	...	...	...	...	16	4	1	3½	9	6	14	Situation too shaded, and soil apparently too dry.
do.	1869	7/6	10	20	18	33	...	...	...	...	12	0	1	5	10	0	14	
do.	1869	1/	...	...	...	...	8	18	30	33	10	6	0	8	7	0	11	Growing on the outside of the enclosure.
do.	1869	1/	...	...	...	...	6	18	24	34	9	8	0	7	5	0	11	Very healthy.
orientalis	1869	5/	4	6	14	12	...	...	...	...	5	6	0	9	4	0	14	Improved in appearance during the past two years.
do.	1869	5/	4	4	8	13	...	...	...	...	5	9	1	2	6	6	14	
do.	1869	2/6	...	...	...	...	4	6	12	12	4	4	0	6½	5	0	10	Appears to be well adapted for growing amongst other trees.

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TABULATED STATEMENT—*continued.*

Names of Plants.	Year when Planted.	Cost.	Annual Growth of Division No. I.				Annual Growth of Division No. II.				Present Height.		Girth at Surface.		Spread of Branches.		Age.	Remarks.
			1869	1870	1871	1872	1869	1870	1871	1872								
			In.	In.	In.	In.	In.	In.	In.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Years.	
Abies Smithiana	1869	7/6	3	3	6	4	...	...	...	...	5	6	1	0	5	0	12	All have been more or less injured by frost, but those in No. II. Division less so.
do.	1870	7/6	...	4	9	6	...	...	...	...	5	3	1	0½	5	0	12	
do.	1869	3/6	...	...	..	...	4	6	8	6	4	0	0	9	4	6	10	
Araucaria imbricata	1869	10/6	4	6	18	5	...	...	...	...	7	4	0	10½	7	6	14	None of these have ever been injured by frost, while within 600 yards; at an elevation of 250 feet they have invariably failed.
do.	1869	10/6	3	8	14	4	...	...	...	...	6	9	0	11	6	6	14	
do.	1869	4/	...	...	...	...	4	8	6	6	4	0	0	7	3	6	12	
do.	1869	4/	...	...	...	...	6	7	9	3	5	0	0	7½	4	0	12	
Biota orientalis	1869	1/6	3	5	5	4	...	...	...	...	3	6	0	5	1	6	10	Both have suffered slightly from frost periodically.
do.	1869	1/6	...	...	...	...	2	5	4	6	3	0	0	5	1	6	10	
aurea	1871	5/	...	...	2	5	...	...	...	...	2	0	0	4½	15	0	7	Has as yet been protected from frost.
do.	1871	5/	...	...	...	...	...	...	3	5	2	3	0	4½	15	0	7	Do. do.
elegantissima	1871	5/	...	...	3	5	...	...	...	...	2	4	0	4½	15	0	7	Do. do.
do.	1871	5/	...	...	...	...	...	...	3	5	2	1	0	4¼	15	0	7	Do. do.
Cedrus Atlantica	1869	1/	5	6	10	9	...	...	...	...	5	0	0	8	4	9	10	Backward the first year, but now growing rapidly.
do.	1869	1/	6	10	14	15	...	...	...	...	6	0	0	7½	6	6	10	
do.	1869	1/	...	...	...	...	6	9	16	18	6	6	0	7½	6	0	10	Doing better than the former.
Deodara	1869	5/	6	18	15	15	...	...	...	...	8	0	1	1¼	6	6	12	It has been difficult to get leaders formed in No. I., and some of the plants had to be severely pruned. Leaders have come away better in No. II. Division.
do.	1869	5/	3	8	14	17	...	...	...	...	6	6	1	0	6	0	12	
do.	1869	3/6	4	8	10	16	...	...	...	...	5	3	0	9	5	0	11	
do.	1869	3/6	...	...	...	...	3	9	12	12	5	6	0	9	4	6	11	
Deodara argentea	1869	5/	6	6	10	9	...	...	...	...	5	6	0	9½	5	0	12	A good specimen, very pleasing and graceful.
Libani	1869	3/6	3½	12	8	6	...	...	...	...	4	9	0	5	5	0	13	Severely pruned in both Divisions, but have now fair leaders.
do.	1869	3/6	...	...	...	...	4	12	9	9	5	3	0	7	4	6	13	
Cephalotaxus drupacea	1871	2/6	...	...	2	4	...	...	...	...	2	0	0	4½	1	3	7	Although protected with spruce branches during winter, have been all injured by frost.
Cryptomeria Japonica	1871	1/6	...	...	3	9	...	...	...	...	2	9	0	4	2	0	7	
Lobbii	1871	2/	...	...	3	6	...	...	...	...	2	3	0	4	2	0	7	
Cupressus Lawsoniana	1869	7/6	9	12	18	15	...	...	...	...	9	6	1	1½	9	0	13	Have never received a check, are growing beautifully, and seem well suited for the situation. Various in habit.
do.	1869	7/6	7	13	15	12	...	...	...	...	9	0	1	2	10	0	13	
do.	1869	3/6	...	...	...	...	6	11	12	8	6	0	0	8	4	6	11	
do.	1869	3/6	...	...	...	...	7	10	14	12	6	9	0	9	5	3	11	
do. compacta	1869	7/6	4	7½	8	10	...	...	...	...	5	6	1	0½	2	0	12	A very distinct variety, and keeps its character well.
do. stricta	1869	5/	5	8	8	12	...	...	...	...	7	0	1	1	2	6	12	One of the varieties sent out from the Perth Nurseries.

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TABULATED STATEMENT—*continued.*

Names of Plants.	Year when Planted.	Cost.	Annual Growth of Division No. I.				Annual Growth of Division No. II.				Present Height.	Girth at Surface.	Spread of Branches.	Age.	Remarks.
			1869	1870	1871	1872	1869	1870	1871	1872					
			In.	In.	In.	In.	In.	In.	In.	In.	Ft. In.	Ft. In.	Ft. In.	Years.	
Cupressus Lawsoniana variegata aurea	1872	5/	...	...	...	3	...	...	...	...	1 9	0 4½	1 3	7	Made very little progress this season, but is an acquisition.
macrocarpa	1872	3/6	...	...	...	6	...	...	...	...	4 6	0 5¾	2 0	7	Former plants have not stood this climate.
Nutkaensis	1869	5/	4	10	12	18	...	...	...	...	8 6	1 4	7 6	11	
do.	1869	5/	6	9	15	19	...	...	...	...	9 0	0 10	6 0	11	All growing vigorously, but the lateral shoots seem as if they require to be kept in check.
do.	1869	2/6	...	...	...	...	7	13	10	12	6 6	0 6	4 0	9	
do.	1869	2/6	...	...	...	...	8	13	13	11	7 0	0 7	4 6	9	
do. viridis	1869	5/	4	8	10	8	...	...	...	...	5 9	0 8	6 0	11	
Juniperus Canadensis	1869	1/6	3	4	7	7	...	...	...	...	4 9	0 9½	2 6	10	Backward the first two years, but now doing better.
do.	1869	1/6	...	...	...	...	3	3	7	6	4 8	0 9	2 6	10	
Chinensis	1869	2/6	6	9	12	9	...	...	...	...	3 9	0 6½	3 6	10	
do.	1869	2/6	7	10	10	11	...	...	...	...	6 4	0 7½	5 0	10	These have all done well, and in different situations have stood frost with impunity.
do.	1869	2/6	6	12	10	10	...	...	...	...	6 2	0 7	3 6	10	
do.	1869	2/6	...	...	...	...	7	9	10	10	6 6	0 7	4 0	10	
communis compressa	1872	2/6	...	...	...	3	...	...	...	...	1 3	0 3½	0 9	6	A fine distinct variety, and an acquisition if it succeeds.
Hibernica	1869	1/	4	6	8	8	...	...	...	...	5 9	1 1	1 6	9	Both are doing well—*Suecica* appears to be the most tender.
Suecica	1869	1/	5	6	8	6	...	...	...	...	4 9	0 6½	2 6	9	
rigida	1871	5/	...	...	3	6	...	...	...	...	2 6	0 4½	1 3	8	Appears well suited for the situation.
drupacea	1872	21/	...	...	...	4	...	...	...	...	3 6	0 5½	1 3	8	A very fine variety, if it succeeds and stands the climate.
excelsa	1869	2/6	6	8	7	8	...	...	...	...	5 0	0 6½	4 0	9	Several plants of this variety have been lost by frost.
do.	1869	2/6	5	8	8	9	...	...	...	...	5 1	0 6½	4 0	9	
do. stricta	1869	12/6	2	3	5	3	...	...	...	...	3 4	0 7	2 0	9	Apparently hardier than the former.
argentea	1869	2/6	3	3	5½	5	...	...	...	...	4 0	0 6¾	3 0	9	A pleasing variety; seems well suited for the situation.
recurva	1869	5/	6	7	10	8	...	...	...	...	6 6	0 7½	6 6	10	Both very pleasing and distinct varieties, and doing remarkably well.
pendula	1869	2/6	6	6	7	10	...	...	...	...	5 10	0 6¾	6 0	11	
Picea amabilis	1869	30/	6	2	2½	2½	...	...	...	...	9 0	1 4	5 6	11	Some of these varieties have been injured by autumn frosts, but none of them have been affected in spring.
do.	1869	30/	4	7	10	8	...	...	...	...	4 9	0 10	4 0	11	
do.	1869	20/	...	...	...	...	4	8	12	12	5 0	0 10	4 0	11	Inferior plant to the former when planted, but fast gaining on them now.

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TABULATED STATEMENT—*continued.*

Names of Plants.	Year when Planted.	Cost.	Annual Growth of Division No. I.				Annual Growth of Division No. II.				Present Height.		Girth at Surface.		Spread of Branches.		Age.	Remarks.
			1869	1870	1871	1872	1869	1870	1871	1872								
			In.	In.	In.	In.	In.	In.	In.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Years.	
Picea bracteata	1869	5/	4	6	12	12	...	...	...	...	3	0	0	8	4	3	9	Appears to be healthiest in No. II.
do.	1869	5/	...	...	...	...	3	7	12	15	3	3	0	7½	4	0	9	
Cephalonica	1869	4/	2	6	14	13	...	...	...	...	4	8	0	8	4	0	9	Lost leader in the spring of 1870, but now quite recovered.
do.	1869	4/	...	...	...	...	3	6	20	18	5	6	0	8	2	6	9	The points of lateral growth slightly frosted on 8th September, leader uninjured.
Fraseri	1869	4/	3	6	18	6	...	...	...	...	5	10	0	10	4	6	9	Lost leader in the spring of 1872.
do.	1869	4/	...	...	...	...	2	4	11	25	7	0	0	7½	4	6	9	Doing remarkably well.
grandis or Lowii	1869	42/	12	24	40	39	...	...	...	...	15	5	1	6½	10	0	13	Remarkably fast-growing symmetrical plants;
do.	1869	42/	8	12	30	36	...	...	...	...	12	3	1	7	9	0	13	foliage generally slightly browned in spring.
grandis (true)	1869	12 6	6	15	33	36	...	...	...	...	11	8	1	4	8	0	9	Foliage darker green and more glaucous than the
do. do.	1869	12 6	...	...	...	...	6	18	42	46	13	2	1	3	9	0	9	former; most extraordinary rapid growing plants; seem quite at home.
lasiocarpa	1869	30/	8	12	20	30	...	...	...	...	8	6	1	1½	7	6	11	All very fine thriving plants, and have all along taken well to the situation.
do.	1869	30	4	6	18	26	...	...	...	...	8	0	1	4	6	6	11	
do.	1869	15/	...	...	...	...	3½	14	21	21	6	11	0	9½	7	0	9	
do.	1869	15/	...	...	...	...	4	12	10	22	6	10	0	10	6	6	9	
magnifica	1869	42/	3	9	18	20	...	...	...	...	7	2	0	11	4	6	11	Very symmetrical, and improving fast.
do.	1869	42/	4	8	15	14	...	...	...	...	6	2	0	11½	5	3	11	
do.	1869	21/	...	...	...	...	2	6	16	19	6	0	0	8	4	0	10	Inferior to the former when planted, but now fast
do.	1869	21/	...	...	...	...	2	6	15	17	6	0	0	8	4	0	10	gaining on them.
nobilis (seedling)	1869	10/	2	3	24	34	...	...	...	...	11	2	1	7	7	6	13	Very fine specimen, and doing well.
do. do.	1869	10 6	2	3	8	10	...	...	...	...	3	6	0	7½	3	6	9	Doing rather best in No. II. Division.
do. do.	1869	10 6	...	...	...	...	3	3	5	11	3	6	0	7	3	0	9	
nobilis glauca	1869	63	5	20	29	38	...	...	...	...	11	6	1	4½	9	0	13	One of the most handsome specimens in the collection.
do.	1869	63	10	24	32	12	...	...	...	...	11	0	1	6	8	0	13	This plant had 14 inches broken off the leader this season.
do.	1869	42/	...	...	...	...	4	5	12	18	7	10	1	4	5	0	13	These are growing rather fast at the top, but
do.	1869	42/	...	...	...	...	2	7	23	33½	8	0	0	9½	5	0	9	quite healthy.
do.	1869	42/	3	9	13	12	...	...	...	...	7	1	1	0½	6	0	11	Very ornamental; clothed with branches to the
Nordmanniana	1869	42/	4	10	24	24	...	...	...	...	10	3	1	3	7	9	11	ground. Lost one plant in 1870 with white
do.	1869	10 6	4	6	15	18	...	...	...	...	5	0	0	9	5	0	9	scale.
do.																		

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TABULATED STATEMENT—*continued.*

Names of Plants.	Year when Planted.	Cost.	Annual Growth of Division No. I.				Annual Growth of Division No. II.				Present Height.		Girth at Surface.		Spread of Branches.		Age.	Remarks.
			1869	1870	1871	1872	1869	1870	1871	1872								
			In.	In.	In.	In.	In.	In.	In.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Year	
Picea Nordmanniana	1869	10/6	...	...	...	...	2	3	14	9½	4	0	0	8½	3	6	9	As timber trees, these seem to be improved by growing amongst other varieties.
do.	1869	10/6	...	...	...	...	2	2	15	21	5	6	0	9	5	0	9	
pichta	1869	4/	4	4	7	12	...	...	...	...	3	6	0	10½	3	6	10	Both slightly frosted during first two years, but now doing well.
do.	1869	4/	...	...	...	...	2	3	7	11	3	0	0	9	3	0	10	
Pindrow	1869	4/	...	...	...	...	2	2	7	8	3	6	0	4	2	0	9	Did not succeed in No. I., but doing fair in No. II. Division.
Pinsapo	1869	15/	4	13	12	16	...	...	...	...	6	9	1	0	6	0	10	A fine thriving plant.
do.	1869	10/	2	6	8	6	...	...	...	...	5	0	0	10	6	0	10	Lost leader twice, but is still very ornamental.
do.	1869	5/	...	...	...	...	4	6	11	11	3	6	0	8½	4	0	9	All fine thriving plants, seem quite at home.
do.	1869	5/	...	...	...	...	2	5	11	15	4	0	0	6	4	0	9	
balsamea	1869	1/	4	6	10	20	...	...	...	...	5	10	0	7	4	6	9	Lateral growths generally slightly frosted during spring.
do.	1869	1/	...	...	...	...	4	6	12	24	6	6	0	7	4	6	9	
pectinata (common silver fir)	1869	2/ p. 100.	2	2	6	9	...	...	...	...	3	0	0	4½	1	6	9	Compared with the others, doing as well as could be expected.
do. do.	1869		...	...	...	...	2	2	8	10	3	4	0	4½	1	6	9	
Pinus Austriaca	1869		2	3	12	14	...	...	...	...	4	0	0	5½	3	0	8	Small when planted, but growing very rapidly. Doing best in No. II.
do.	1869		...	...	...	...	2	3	13	21	4	6	0	6½	3	0	8	
Benthamiana	1869	5/	2	6	12	12	...	...	...	...	5	10	0	9	4	0	10	Has been too much drawn before being planted.
do.	1869	3/6	...	...	...	...	2	2	7	12	3	6	0	4	2	6	8	A very fine plant.
Cembra	1869	1/	3	4	6	12	...	...	...	...	3	6	0	5	1	6	8	
do.	1869	1/	5	7	12	15	...	...	...	...	4	7	0	6¾	2	0	8	All doing very well in both Divisions.
do.	1869	1/	...	...	...	...	1	2	9	10	3	0	0	6	2	0	8	
Jeffreyii	1869	5/	3	6	8	13	...	...	...	...	5	8	0	8	3	0	10	Has been too much drawn before being planted.
do.	1869	3/6	...	...	...	...	1	3	12	12	3	0	0	5	2	6	8	A fair proportioned plant.
Laricio	1869	12/6 p. 100	2	6	12	18	...	...	...	...	4	9	0	6	2	6	8	All small plants when planted, doing best in No. II.
do.	1869		...	...	...	...	2	5	18	23	5	0	0	6	2	11	8	
do.	1869		...	...	...	...	4	7	22	27	6	2	0	6½	3	10	8	

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TABULATED STATEMENT—*continued.*

Names of Plants.	Year when Planted.	Cost.	Annual Growth of Division No. I.				Annual Growth of Division No. II.				Present Height.		Girth at Surface.		Spread of Branches.		Age.	Remarks.
			1869	1870	1871	1872	1869	1870	1871	1872								
			In.	In.	In.	In.	In.	In.	In.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Years.	
Pinus excelsa . .	1869	5/	5	8	7	16	...	...	...	...	4	6	0	6½	3	0	10	Seemed rather backward the first year, but are now doing well.
do. . . .	1869	5/	3	8	12	12	...	...	...	...	4	6	0	6½	2	6	10	
do. . . .	1869	3/6	...	...	...	...	3	5	12	8	3	8	0	7	3	4	9	Very fine specimen, but has lost its leader this season.
monticola . .	1869	3/6	2	7	6	7	...	...	...	...	3	4	0	6	2	6	9	Both plants similar when planted, but the one in No. II. Division is now the best specimen.
do. . . .	1869	3/6	...	...	...	...	4	10	8	15	4	10	0	6½	2	6	9	
Murrayana . .	1869	3/6	...	...	...	...	2	3	5½	7	2	9	0	4½	1	10	9	Small plant, but thriving well.
ponderosa . .	1869	5/	4	6	15	13	...	...	...	...	7	0	0	11	5	0	11	A very ornamental variety, but rather too much drawn.
do. . . .	1869	3/6	...	...	...	...	2	2	10	12	4	0	0	5	2	6	9	A more ornamental specimen than the former.
Pallasiana . .	1869	3/6	...	...	...	...	3	3	10	13	3	6	0	5½	3	6	9	
Pumilio . . .	1869	5/ p. 100	3	5	6	6	...	...	...	...	2	6	0	4½	2	6	9	Are very thriving, but grown only for variety.
do. . . .	1869		...	...	...	...	3	5	6	6	2	6	0	4½	2	6	9	
Pyrenaica . .	1869	3/6	...	...	...	...	2	3	17	19	4	7	0	6	3	6	9	Small plant, but fine specimen.
Retinispora filifera .	1871	5/	...	...	3	6	...	...	...	...	2	9	0	4	1	3	7	Stood unprotected last season and is uninjured.
obtusa . . .	1869	21/	4	6	12	14	...	...	...	...	5	6	0	6½	6	6	10	Particularly handsome, and doing well.
do. nana . .	1871	7/6	...	...	2	4	...	...	...	...	2	0	0	3½	1	0	7	Stood unprotected last season.
pisifera . .	1869	21/	4½	8	8	12	...	...	...	...	5	6	0	7½	6	6	10	Very fine variety; quite hardy and doing well.
do. . . .	1871	7/6	...	...	3	9	...	...	...	...	3	0	0	4	1	2	7	Stood unprotected last season.
aurea . . .	1871	5/	...	...	2	4	...	...	...	..	2	0	0	4	1	0	7	These were all unprotected last season.
Plumosa . .	1871	5/	...	...	3	4	...	...	...	...	2	6	0	4	0	10	7	
squarrosa . .	1871	3/6	...	...	2	2	...	...	...	...	2	0	0	4	0	10	7	
do. argentea	1871	3/6	...	...	1	3	...	...	...	...	1	10	0	3½	0	9	7	
Sequoia sempervirens .	1870	2/6	...	4	6	10	...	...	...	...	3	6	0	5½	1	6	8	Stood unprotected during last winter.
Wellingtonia gigantea .	1869	10/6	9	18	18	21	...	...	...	...	9	0	0	10	7	6	12	Very fine specimens, apparently well adapted to the situation.
do. . .	1869	10/6	8	27	33	24	6	14	16	20	12	9	2	2	7	6	12	
do. . .	1869	10/6	...	...	...	...	6	18	26	28	9	3	1	5	7	6	12	Fine specimen plant; has not been injured by frost.
do. . .	1869	3/	...	...	...	...	...	...	...	...	9	0	1	0	6	3	10	A beautiful plant, but the points of lateral branches are frosted.
do. variegata	1872	21/	...	...	...	6	...	...	...	...	2	3	0	5½	2	0	6	Will be an acquisition if hardy.

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TABULATED STATEMENT—*continued.*

Names of Plants.	Year when Planted.	Cost.	Annual Growth of Division No. I.				Annual Growth of Division No. II.				Present Height.		Girth at Surface.		Spread of Branches.		Age.	Remarks.
			1869	1870	1871	1872	1869	1870	1871	1872								
			In.	In.	In.	In.	In.	In.	In.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Years.	
Taxus baccata	1870	/9	...	4	7	10	...	...	...	...	3	0	0	4	1	9	8	Small plants, but growing luxuriantly.
do. variegata	1871	5/	...	...	6	8	...	...	...	...	3	0	0	4	1	3	8	These have all stood unprotected during last winter.
do. argentea																		
do. do. aurea	1871	5/	...	...	6	8	...	...	...	...	3	6	0	4½	1	4	8	
elegantissima	1871	3/6	...	...	3	4	...	...	...	...	2	4	0	4	1	6	8	
fastigiata	1869	3/6	4	6	6	10	...	...	...	...	6	3	0	8	2	0	11	Very healthy and thriving.
Nidpathensis	1869	1/6	4	6	8	11	...	...	...	...	4	0	0	5½	4	6	9	
Thuja gigantea	1869	5/0	4	8	7	8	...	...	...	...	5	6	0	9½	4	0	11	Beautiful varieties, but apparently slow growers.
do.	1869	5/	4	8	8½	9	...	...	...	...	6	0	0	9½	4	6	11	
do.	1869	5/	...	...	...	...	3	8	9	11	6	2	0	9	4	0	11	
Menziesii or Lobbii	1869	7/6	12	18	30	30	...	...	...	...	13	9	1	5½	7	6	14	Very rapid growers, called "Gigantea" by some.
do.	1869	7/6	10	24	30	36	...	...	...	...	11	3	1	2½	7	0	14	
do.	1869	3/6	...	...	...	...	6	10	24	22	8	3	0	9	5	0	9	
occidentalis	1869	1/	3	10	12	14	...	...	...	...	8	6	0	10½	4	6	10	A very fine specimen; previous to planting had been trained in a fastigated form.
do.	1869	/9	3	5	5	14	...	...	...	...	4	0	0	6	4	0	8	Small when planted, but growing remarkably well.
do.	1869	/9	...	...	...	...	2	5	4	16	4	0	0	5½	3	6	8	
plicata or Warreana	1869	1/	3	3	5	4	...	...	...	...	3	3	0	6	2	0	9	Very distinct variety, and apparently well adapted for situation.
do.	1869	1/	...	...	...	...	3	3	5	8	3	6	0	6	2	0	9	
Thujopsis dolabrata	1872	7/6	...	...	...	3	...	...	...	...	1	6	0	3½	1	3	7	Apparently well adapted for situation. Stood unprotected last winter.
ORNAMENTAL TREES AND SHRUBS.																		*Note.*—Small plants and varieties with more than one stem are not girthed at surface.
Acer campestre	1869	/6	6	8	12	12	6	10	14	14	7	0	0	6½	6	0	8	
colchicum	1869	/9	8	10	10	12	6	10	12	18	8	6	0	8	6	0	8	
do. rubrum	1870	/9	...	6	14	15	...	...	...	...	7	3	0	8	5	6	8	Growing too tall for its present situation.
macrophyllum	1870	1/	...	5	12	18	...	...	...	...	7	6	0	7½	5	0	8	
negundo	1869	/6	6	4	12	12	6	6	12	16	7	0	0	7	5	0	8	
stricta	1869	/6	4	4	14	12	4	6	12	16	6	6	0	7	4	6	8	
Platanoides	1869	2/6 p. 100	12	15	24	30	15	24	26	36	12	6	0	10	6	0	8	Growing very fast and proportionate, especially in No. II. Div. Some of the annual growths are upwards of 6 feet.
Pseudo Platanus	1869		6	4	8	14	6	12	12	20	9	6	0	9	4	6	10	

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TABULATED STATEMENT—*continued.*

Names of Plants.	Year when Planted.	Cost.	Annual Growth of Division No. I.				Annual Growth of Division No. II.				Present Height.		Girth at Surface.		Spread of Branches.		Age.	Remarks.
			1869	1870	1871	1872	1869	1870	1871	1872								
			In.	In.	In.	In.	In.	In.	In.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Years.	
Acer Pseudo purpurea	1869	1/	4	6	8	10	...	...	...	...	9	0	0	6½	4	6	10	Not exactly true to name, but a fine plant.
do. alba variegata	1869	1/	4	4	6	4	...	...	...	...	5	9	0	8	4	0	8	Healthy, but making little progress.
do. Corstorphine	1869	1/	4	3	4	10	...	...	...	...	6	1	0	8½	4	6	9	
other 10 varieties	1872	1/	...	...	...	6	...	...	...	...	5	0	0	6½	2	6	7	
Æsculus Hippocastanum	1869	/6	4	6	12	24	4	6	18	26	6	0	0	7	3	6	8	All growing freely, especially in No. II. Division.
coccinea	1869	1/	3	8	6	12	6	6	10	15	6	6	0	6	2	6	8	
flore pleno rubra	1869	1/	3	6	10	16	4	6	8	18	6	6	0	8	4	0	8	
spectabilis	1872	2/6	...	...	...	6	...	...	...	...	4	6	0	7	3	6	5	
rubicunda	1872	/6	...	...	...	5	...	...	...	...	4	0	0	7	3	6	5	
Alnus Americana	1869	2/6	6	12	12	18	...	..	..	...	10	0	0	10	7	0	8	Though growing well, apparently prefer a more moist soil and situation.
incana	1869	/3	4	10	8	11	6	6	8	12	6	6	0	7	4	0	8	
Hudsonica	1871	1/6	...	...	6	10	...	...	...	...	6	0	0	6½	2	6	6	All distinct varieties. If they succeed and grow to a moderate size, will be an acquisition amongst ornamental trees.
ovata	1871	1/6	...	...	6	13	...	...	...	...	5	6	0	5½	2	6	5	
other 6 varieties	1872	1/	...	...	...	6	...	...	...	6	5	0	0	4½	2	0	5	
Amygdalus communis	1869	/6	4	4	10	8	...	...	...	...	6	0	0	7	2	6	9	Kept for the sake of variety. It is doubtful if all will stand the climate.
dulcis	1869	/6	3	6	6	11	...	...	...	...	6	3	0	7	2	6	9	
other 3 varieties	1872	1/	...	..	...	4	...	...	...	...	4	6	0	5	2	0	7	
Arbutus, varieties,	1869	1/6	3	4	4	4	...	...	...	...	2	6	...		2	6	10	
Aucuba Japonica (com.)	1869	/6	2	2	3	3	2	2	3	5	2	0	...		2	6	10	Planted in groups adjacent to each other.
male and female var.	1872	1/6	...	...	...	2	...	...	...	...	2	0	...		2	6	8	
Azalea (Ghent), var.	1869	1/6	2	2	3	5	...	...	...	...	2	0	...		2	3	10	
Ponticum	1869	1/	2	4	4	6	2	4	4	6	2	6	...		2	0	9	
Berberis Darwinii	1869	/6	4	6	18	20	6	6	18	22	5	0	...		3	0	8	By far the best of the varieties, and a great acquisition.
dulcis	1869	/3	6	6	12	12	6	10	12	16	4	6	...		2	6	8	
vulgaris	1869	/3	4	6	12	10	6	10	12	12	4	6	...		2	6	8	
Betula asplenifolia	1869	2/	6	8	14	18	...	...	...	...	7	6	0	6	2	6	10	A very pretty foliage. and growing well.
laciniata pendula	1870	2/	...	6	10	18	...	...	...	...	8	6	0	5½	3	0	10	
populifolia	1870	1/	...	15	18	24	...	...	...	...	9	0	0	6	7	0	9	Growing too tall for its present position.
other common var.	1869	/3	6	12	16	18	6	12	18	30	10	0	0	9	6	6	9	Fine varieties of the White Bark Weeping, and doing well in both Divisions.
Buxus, several varieties	1869	/6	3	3	4	4	3	3	4	4	2	0	...		2	6	9	
Carpinus, Americana	1869	/9	6	8	12	14	8	7	14	16	6	6	0	6½	3	0	8	Doing very well in both Divisions.
Betulus	1869	/9	6	8	14	12	8	10	14	18	6	6	0	7	3	6	8	

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TABULATED STATEMENT—*continued.*

Names of Plants.	Year when Planted.	Cost.	Annual Growth of Division No. I.				Annual Growth of Division No. II.				Present Height.		Girth at Surface.		Spread of Branches.		Age.	Remarks.
			1869	1870	1871	1872	1869	1870	1871	1872								
			In.	In.	In.	In.	In.	In.	In.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Years.	
Carpinus incisa	1870	1/	...	4	6	10	...	...	...	...	4	0	0	5	2	0	8	
heterophylla	1872	1/	...	...	...	4	...	...	...	...	3	6	0	4	1	6	6	
Carya, 2 varieties	1872	/9	...	...	...	4	...	...	...	...	3	6	0	4	1	3	6	
Castanea Americana	1870	/6	...	4	6	10	...	4	7	12	3	6	0	4	1	3	6	
Vesca	1870	1/	...	3	8	10	...	...	...	...	4	0	0	4½	1	3	6	Grown principally for ornament, but some of the varieties are good timber trees.
other 3 varieties	1872	1/	...	...	...	4	...	...	...	...	3	0	0	3½	1	0	5	
Cerasus, Bay Laurel (com.)	1869	/6	6	8	8	12	6	10	12	14	3	0	...		3	9	9	Remarkably vigorous in growth.
Caucasica	1872	1/	...	...	...	4	...	...	...	...	1	4	...		1	6	5	Stand frost better than the former, and are pretty plants.
Colchica	1870	1/	...	4	7	7	...	...	...	...	2	0	...		2	0	7	
Portugal Laurel	1869	/6	4	7	12	12	4	6	10	10	3	6	...		4	0	9	Growing very luxuriantly, especially in Div. I.
Padus (bird cherry)	1869	/6	5	10	10	15	...	...	...	...	7	0	0	8	4	6	8	
sylvestris flore pleno	1869	1/6	6	10	12	12	6	10	12	14	7	6	0	10	5	6	9	
Cornus alba	1869	/4	8	18	18	24	...	...	...	...	5	0	...		10	0	9	An extraordinary plant to grow; seems well adapted for underwood.
variegata (standards)	1869	2/	4	6	6	8	...	...	...	...	7	0	...		1	3	9	Beautiful plant, but the laterals are periodically frosted back to the head.
do. mascula	1869	1/	4	6	8	6	...	...	...	...	5	0	...		2	0	9	Stands exposure much better than the former.
sanguinea	1872	/6	...	...	...	6	...	...	...	...	2	0	...		1	3	5	
Cotoneaster buxifolia	1871	/6	...	...	6	6	...	...	...	...	...		...		2	0	6	Grow on the rockeries and wall adjoining.
microphylla	1871	/3	...	...	4	6	...	...	...	...	...		...		2	6	6	
Simonsii	1869	/6	8	10	12	14	10	12	12	16	6	6	...		6	0	8	A free growing plant, but rather straggling in habit.
Cratægus coccinea	1869	/9	4	6	10	8	...	...	...	...	7	0	0	7½	3	6	9	
latifolia	1869	/9	4	4	7	11	...	...	...	...	7	0	0	7	3	0	9	
pendula	1869	2/	8	10	12	12	...	...	...	...	6	6	0	7	5	0	9	Most of these are becoming top heavy, and require to be reduced in size.
Paul's new double	1869	5/	6	8	16	16	...	...	...	...	8	6	0	10	6	0	9	
other common var.	1869	/9	6	8	14	15	...	...	...	...	8	6	0	9	6	0	9	
4 new var.	1872	1/	...	...	...	6	...	...	...	...	5	0	...		2	0	5	
Cytisus, several var.	1869	/3	8	12	12	15	6	10	14	16	7	0	0	8	5	0	9	
Daphne Laureola	1869	/6	3	4	4	4	...	...	...	...	2	0	...		3	6	9	Not to be relied upon as perfectly hardy, still they deserve a place, as the two latter are very ornamental in spring.
Mezereum	1869	1/6	2	2	4	4	...	...	...	...	2	0	...		2	0	9	
Atropurpureum	1869	1/6	2	2	4	6	...	...	...	...	2	6	...		2	0	9	
alba	1869	1/6	2	1	1	1	...	...	...	...	1	2	...		1	0	9	Has been frosted periodically—much injured.
Deutzia corymbosa	1869	/9	6	12	12	18	...	...	...	...	4	6	...		3	0	8	Fine ornamental and hardy plants.
scabra	1869	/6	6	12	12	16	...	...	...	...	4	6	...		3	0	8	

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TABULATED STATEMENT—*continued*.

Names of Plants.	Year when Planted.	Cost.	Annual Growth of Division No. I.				Annual Growth of Division No. II.				Present Height.		Girth at Surface.		Spread of Branches.		Age.	Remarks.
			1869	1870	1871	1872	1869	1870	1871	1872								
			In.	In.	In.	In.	In.	In.	In.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Years.	
Escallonia, varieties	1869	/6	...	...	...	...	5	10	10	18	5	0	...		2	6	9	
Fagus asplenifolia	1869	1/	2	6	6	14	...	...	...	...	7	0	0	7	3	6	10	These made little progress till this year, but seem to take well with the ground now.
cristata	1869	1/	4	4	10	12	...	...	...	...	6	6	0	7	4	0	8	
pendula	1869	1/6	3	4	8	6	...	...	...	...	7	0	0	8	3	0	9	
purpurea	1869	1/	6	12	10	18	8	10	14	16	9	6	0	7½	5	6	9	Many of these are light copper coloured.
Fraxinus excelsior	1869	3/ p. 100	4	8	12	16	6	12	10	18	9	6	0	7½	5	6	9	Making rapid progress, and is healthy in both Divisions.
aucubifolia	1869	1/	6	8	12	12	...	...	...	...	7	0	0	6½	2	0	8	
integrifolia	1869	/9	6	6	8	7	...	...	...	...	9	0	0	9½	4	0	10	Transplanted from an adjoining belt to this enclosure.
nigra	1869	1/	6	4½	6	6	...	...	...	...	8	0	0	9	3	6	9	
other 4 var.	1872	1/	...	...	...	4	...	...	...	...	5	0	...		1	9	9	
Genista, var.	1869	1/	4	13	12	12	...	...	...	...	4	6	...		2	0	9	
Hedera Helix (ivy)	1870	/6	...	6	12	18	...	...	...	...	6	0	...		...		6	Growing on the rockery and adjoining wall.
Hippophae rhamnoides	1870	/3	...	4	6	12	...	...	...	...	2	6	...		2	0	7	Growing almost as freely as willows.
salicifolia	1870	1/	...	6	8	11	...	...	...	...	2	0	...		2	0	7	
Ilex (holly), Queen golden	1869	21/	8	12	18	18	...	...	...	...	9	1	0	11	3	6	12	This is the centre of a group of holly near the middle of the ground.
do. silver	1869	2/6	2	6	12	12	...	...	...	...	3	6	...		2	0	9	
other 10 var., green leaved	1869	3/	4	6	12	14	...	...	...	...	5	0	0	9	5	6	11	All growing freely.
other 10 var. variegated	1869	1/6	4	6	12	20	...	...	...	...	5	0	0	6½	4	0	9	
Evergreen Oak, 2 var.	1869	2/6	6	6	10	12	...	...	...	...	3	0	...		2	6	9	
Juglans (Walnut)	1872	1/6	...	...	...	4	...	...	...	...	4	6	0	6	2	0	6	
Leycesteria formosa	1869	/9	12	18	24	24	...	...	...	...	3	0	...		2	6	9	Generally frosted to near the ground periodically.
Ligustrum, 2 var.	1869	/6	6	14	14	18	8	12	16	18	4	6	...		2	6	7	Both varieties before the common sort, and as easily cultivated.
Liriodendron tulipifera	1872	1/	...	...	...	6	...	...	...	...	4	6	0	6½	2	0	6	
Lonicera, var.	1869	/6	6	6	12	12	...	...	...	...	5	6	...		3	6	9	
Laurestine, var.	1869	/4	4	6	6	6	...	...	...	...	3	0	...		4	0	8	Growing well in both Divisions, apparently quite hardy.
Mahonia Japonica	1869	1/	4	7	6	6	...	...	...	...	3	0	...		2	0	9	A fine variety, but rather tender.
other 2 var.	1869	/3	3	7	7	10	...	...	...	...	2	6	...		4	0	9	
Mespilus (Medlar)	1872	1/	...	...	...	4	...	...	...	...	4	6	0	6	2	0	6	Grown chiefly for variety and ornament.

TABULATED STATEMENT—*continued.*

Names of Plants.	Year when Planted.	Cost.	Annual Growth of Division No. I.				Annual Growth of Division No. II.				Present Height.		Girth at Surface.		Spread of Branches.		Age.	Remarks.
			1869	1870	1871	1872	1869	1870	1871	1872								
			In.	In.	In.	In.	In.	In.	In.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Years.	
Morus (Mulberry), 2 var.	1872	1/	...	...	...	7	...	...	...	...	5	0	0	6½	2	6	6	Grown chiefly for variety and ornament.
Pernettya floribunda .	1869	/10	3	8	3	6	...	...	...	...	1	6	...		2	6	8	
mucronata . .	1869	/10	3	3	6	12	...	...	...	...	2	6	...		3	6	8	
Philadelphus grandiflorus	1871	/6	...	...	8	12	...	...	...	...	5	0	...		2	6	8	All free growing, and some of them very ornamental.
other 5 var. . .	1869	/6	6	6	12	12	...	...	...	...	5	6	...		3	0	10	
Platanus occidentalis .	1870	2/6	...	4	6	10	...	4	5	9	5	8	0	7	2	6	8	Healthy, but not growing so fast as the commoner varieties.
orientalis . .	1870	2/6	...	6	7	13	...	6	9	15	6	6	0	7	3	0	9	
other 2 var. . .	1871	1/	...	...	6	6	...	...	...	...	4	6	0	5½	2	0	8	
Populus alba (new var.)	1869	1/6	9	12	18	18	6	10	18	24	9	0	0	8	5	0	8	All are very effective, and have a striking appearance amongst the other trees. They are free growers.
abele . . .	1869	/6	10	12	18	30	10	15	24	30	10	6	0	8½	7	0	8	
nivea . . .	1869	/6	8	8	12	12	6	10	12	17	7	0	0	6½	3	0	8	
tremula . . .	1869	/3	4	6	10	8	6	8	10	13	7	0	0	5½	4	0	8	
other common sorts	1869	3/ p. 100	8	18	24	32	10	18	24	30	12	0	0	11	7	0	8	
other 10 var. (new)	1872	1/	...	...	...	6	...	...	...	...	4	6	...		2	0	5	
Potentilla fruticosa .	1869	/6	2	2	6	6	...	...	..	...	1	9	...		2	6	8	
Pyrus, several var. .	1872	1/	...	...	...	5	...	...	...	...	4	6	0	5½	2	0	9	Cultivated chiefly for the appearance of their foliage in autumn.
Quercus cerris (Turkey)	1869	/6	6	8	14	18	6	10	14	16	8	0	0	9½	6	0	9	Growing remarkably well, especially in No. II. Division.
Lucombeana . .	1869	3/	4	16	8	10	...	...	...	...	3	6	...		5	0	10	Has been twice cut to the ground.
pedunculata . .	1869	2/6 p. 100	4	8	10	12	4	10	10	14	6	6	0	7	5	0	9	Thriving, but not growing so rapidly as the Turkey oak.
Rhamnus, 4 var. . .	1869	1/6	6	10	10	10	...	...	...	...	3	6	...		4	6	9	
Rhododendron Ponticum	1869	/6	4	6	6	8	4	4	6	8	3	6	...		3	0	9	Growing as luxuriantly as if they were on moss.
hybrid . . .	1869	2/6	4	6	7	6	...	...	...	...	3	6	...		3	6	9	
hirsutum . .	1869	1/	...	...	...	...	...	...	...	...	1	0	...		1	6	9	Not very suitable for this situation.
Ribes aureum . .	1872	/6	...	...	..	6	...	...	...	...	2	0	...		2	0	5	
other 4 var. . .	1869	/3	6	12	24	24	6	10	18	26	5	6	...		8	0	8	Has a tendency to overgrow and break down.
Salix, common var. .	1869	4/ p. 100	9	12	10	18	9	18	24	30	12	0	0	9	7	0	8	
Kilmarnock Weeping	1869	1/6	6	8	10	10	...	...	...	...	6	0	0	7	3	0	8	
American Weeping	1869	1/6	6	10	8	12	...	...	...	...	7	0	0	8	3	6	8	

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TABULATED STATEMENT—*continued.*

Names of Plants.	Year when Planted.	Cost.	Annual Growth of Division No. I.				Annual Growth of Division No. II.				Present Height.		Girth at Surface.		Spread of Branches.		Age.	Remarks.
			1869	1870	1871	1872	1869	1870	1871	1872								
			In.	In.	In.	In.	In.	In.	In.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Years.	
Salix, other 6 new var.	1872	1/	...	...	...	12	...	...	...	...	5	6	...		2	0	5	Particularly interesting, but doubtful if they will become trees.
Sambucus nigra (common Elder)	1869	/3	6	8	14	18	6	12	18	18	6	0	...		5	0	8	
scarlet fruited	1869	/6	8	12	24	36	12	24	36	42	10	0	...		9	0	8	An extraordinary fast grower. Too large for this collection.
Spiræa adiantifolia	1869	/6 each	6	12	10	12	...	...	...	...	7	0	...		4	6	8	Very pretty and graceful when in flower.
ariæfolia	1869		4	10	10	12	...	...	...	...	7	0	...		5	0	8	
callosa	1869		6	10	12	12	...	...	...	...	6	6	...		7	0	8	Flowers freely.
corymbosa	1869		6	8	12	18	...	...	...	...	6	6	...		4	6	8	
Douglasii	1869		6	8	14	18	...	...	...	...	6	0	...		4	0	8	
Foxii	1869		6	10	8	14	...	...	...	...	5	0	...		8	0	8	Flowers freely during great part of the season.
Opulifolia	1870	1/	...	6	12	18	...	...	...	...	5	6	...		2	6	7	
Symphoricarpus, 2 var.	1869	/3	8	12	18	18	...	...	...	...	5	6	...		5	0	8	
Syringa Josikæa	1869	/9 each	8	12	18	18	...	...	...	...	5	6	...		5	0	8	Flowered this season.
Persica	1869		6	8	13	13	...	...	...	...	4	6	...		4	0	8	Do. do.
Charlemagne	1869		6	10	10	10	...	...	...	...	5	0	...		4	0	8	A fine formed plant, but has not flowered.
Charles X.	1869		4	10	8	10	...	...	...	...	4	6	...		3	6	8	Flowered during the last two seasons.
grandiflora	1869		4	12	12	14	...	...	...	...	5	6	...		3	0	8	Flowered this season.
Triomphe d'Orleans	1869	1/	4	8	14	15	...	...	...	...	5	0	...		4	0	8	Neither of these plants have flowered.
Prince Nottiger	1869	1/6	6	8	8	14	...	...	...	...	4	0	...		3	6	8	
Tamarix gallica	1870	1/	...	12	18	18	...	...	...	...	2	6	...		1	0	7	Cut to the ground by frost almost periodically, but grows freely.
Tilia Europæa	1869	/3	6	12	12	18	6	12	14	20	8	6	0	8	6	0	9	Several varieties, all growing very well.
alba	1872	1/6	...	...	...	3	...	...	...	...	2	6	...		1	0	5	
asplenifolia	1872	1/	...	...	...	6	...	...	...	...	3	0	...		1	0	5	Fine varieties, but plants as yet are small.
grandifolia	1872	1/	...	...	..	6	...	...	...	...	3	0	...		1	0	5	
Ulmus montana	1869	2/ p. 100	6	14	18	30	8	14	24	33	11	6	0	10	7	0	8	Growing very well, especially in No. II. Division.
Camperdown	1869	1/6	6	8	10	10	7	8	11	13	7	0	0	9	5	0	9	All grafted, and most have wide-spreading heads.
several pendulas	1869	2/6	6	6	10	13	6	8	12	10	8	0	0	10	5	0	9	
other 4 new varieties	1872	1/	...	...	...	6	...	...	...	...	5	0	0	4½	2	3	5	
...rnum, varieties	1869	/6	6	10	12	12	...	...	...	...	5	6	...		3	0	8	Grows freely, and quite hardy.

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IV. *Report on the Houston Pinetum.* By WILLIAM TIVENDALE, Forester, Houston, Paisley.

In the spring of 1867 we were allowed to take about two acres of ground to be planted as a Pinetum. It is situated at an elevation of nearly 100 feet above the level of the sea, and has a north-eastern exposure. The soil is a good light loam, of considerable depth, resting partly on gravel and partly on sand, and is very well adapted for growing most of the coniferous trees. This piece of ground had formerly been enclosed by a dry stone dyke on the south and east, by a stone and lime wall 6 feet high on the west, and by a strong wire fence on the north. The stone and lime wall being on the public road, and in good repair, was allowed to stand, as also the wire fence; but the dry stone dyke, being no longer required as a fence for cattle, &c., was removed, the small stones being left for bottoming the walks of the pinetum. A row of old hardwood trees being on the side of this fence, under the drop of which pines will not grow, we had to trench a border about 24 feet wide, and as deep as possible, without injuring the roots of the trees. This being done, we proceeded to make the walks; the soil was taken out to the depth of 12 inches, and 48 inches wide, and put on the trenched border which was to be planted with evergreens. 6 inches of small stones were put in the bottom of the walk, which were blinded with an inch of engine ashes; 3 inches of fine gravel was laid on the top of the ashes, leaving the edge of the walk about 3 inches high.

As it was necessary to keep out hares and rabbits, we put up wire netting, the posts for which were cut from matured larch trees, 4 feet long, and 3 inches by 2½ inches square. They were driven 1 foot into the ground, at 6 feet from post to post; 6 inches of soil were taken out with the spade all along the outside of the row of posts, and a rafter of larch was nailed to the posts under the natural surface of the ground. A No. 8 wire was threaded through the top meshes of the netting as it was being rolled out along the side of the fence; this wire is strained at the ends of the fence; the netting is then tightened, and the wire is stapled to the posts, about 2 feet 10 inches above the ground, leaving about 2 inches to be stapled to the rafters under the surface, which prevents rabbits from creeping under the wire netting. The soil taken out for the rafter is again put in, and made firm by tramping with the feet, and all made level.

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A *Pinus excelsa*

B *Pinus insignis*

C *Araucaria imbricata*

X *Evergreen Holly* (*Ilex Aquifolium*)

V *Maple, English* (*Acer campestre*)

W *Chestnut, Spanish* (*Castanea Vesca*)

\+ *Weymouth Pine* (*Pinus Strobus.*)

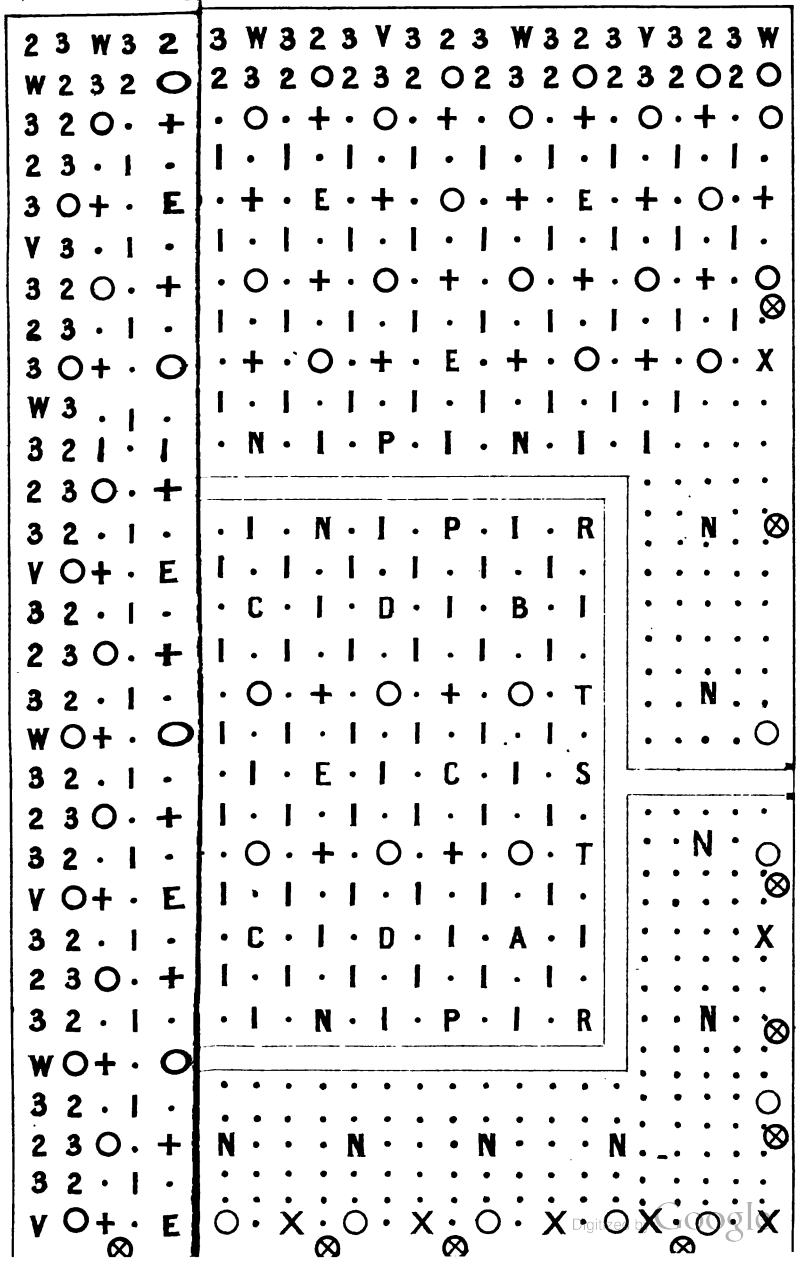
O *Portugal Laurels.*

O *Austrian Pine* (*Pinus Austriaca*)

I *Silver Fir* (*Picea pectinata*)

• *Corsican Pine* (*Pinus Larilio.*)

• *Rhododendrons.*



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Wire netting was also put on the posts of the wire fence on the north side, and done in the same manner, only the netting was put on inside the posts here, in order to prevent it from being damaged by cattle grazing in the adjoining field.

These operations being completed, we next proceeded to make the pits for the principal or ultimate crops: these were round, 3 feet in diameter, and 18 inches deep. After the turf was neatly taken off, and the soil thrown out to the desired depth, the bottom of the pit was dug all round the full depth of the spade; 6 inches of the soil taken out was then put into the pit, and a couple of handfuls of hot lime added, and thoroughly mixed with soil (this is the best thing we know of for the making of fibre). All the pits being made in this manner for the principal trees, we next made pits for the nurses: they were 18 inches in diameter, and 12 inches deep, stirred in the bottom with the spade, and 6 feet from pit to pit, all over the ground. The plants, which varied in height from 1 to 2 feet were then brought forward, and all the principals were planted first with every care and caution. No tramping with the feet was allowed until the whole of the soil was replaced; then it got a gentle tramp all round, and the plant made firm at the neck, which is all that is necessary. The nurses were then pitted in the same way, and all finished in a satisfactory manner. The border was next proceeded with, and finished. We refer the reader to the diagram for the kinds of plants, and the arrangement on the ground. They are all represented by different characters (letters, &c.). The plants have all done admirably well, excepting *Pinus Pinsapo* and *Picea cephalonica;* these have not grown more than 2 inches a year since they were planted, till this year, when they have made a little more. The other plants have made an average growth of 7 inches; *Abies Douglasii* and *Pinus Laricio* have succeeded best, some of them having 26 inches growth this year (1872). No deaths have occurred among the pines, but about 5 per cent. of the silver firs died, which were at once removed, and others put in their place. The whole are now looking well, and promise to become trees of considerable size. Of course we do not expect them to attain the gigantic size in this country which they reach in their native land, and have kept the principals a little closer than some people do in consequence.

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V. *Report on the Comparative Advantages of the different Methods of Pruning.* By ANDREW GILCHRIST, Forester, Urie House, Stonehaven.

Notwithstanding the existence for the last eighteen years of an Arboricultural Society, the primary object of which is by the offering prizes for practical essays and reports, to endeavour to disseminate a knowledge of the principles and practice of arboriculture, so that we may attain, as far as practicable, to a uniform and sound method of practice in the planting and rearing of forest trees; and also the very commendable manner in which the Highland and Agricultural Society that has encouraged writers to send in reports, and the many articles have from time to time appeared in the agricultural section of the public press;—although all these engines have been at work, there is still not a few of the departments of modern forestry on which there exists a considerable difference of opinion. If we are not mistaken, the great arboricultural want of our day is a correct and comprehensive knowledge of the first principles of arboriculture. At present there is no want of empirical rules, founded on a practice that is supposed to be successful; but, as a general rule, these empiric systems are not reliable. And the man with a scientific knowledge always doubts them until he has fully tested them, and found them in harmony with the laws of vegetable physiology. A thorough knowledge of these laws, and then the earnest endeavour to harmonise our various operations, so that they may become as mild in their opposition to these laws as possible, is beyond all question the proper method to obtain a uniform and definite system of practice, founded on accurate and undoubted first principles.

The pruning of forest trees is one of those branches of modern forestry which is uniformly important, whether we consider it from a scientific or a practical point of view, and regarding which there is an absolute necessity that sound and definite first principles should exist. During recent years the discussion of this subject has attracted much attention; but though often discussed and studied even by men with a first-rate scientific knowledge and a sound practical experience, and who have had good opportunities of investigating, and without prejudice recording their conclusions, still many conflicting opinions prevail. Theory is opposed to theory, and the methods of operating are the same. If we begin to discuss the subject with foresters here and there throughout the country, we not

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only find that many diverse opinions are held, and the most opposite methods practised, but also that some of the various modes of operating are founded not on sound principles, but on the most incompatible theories.

In pruning, perhaps more than any other department of practical arboriculture, we have it within our power to adopt an almost uniform system of operation; but for want of due attention being paid to sound and definite fundamental principles, there is scarcely a point on which absolute unanimity of opinion or practice exists. We do not mean to assert that an absolute law could be laid down that would be applicable to every peculiarity of kinds and ages of trees, so that the precise time to operate at the first and all subsequent prunings could be determined without first having examined and acquired a knowledge of the trees to be operated on. A certain amount of practical skill, along with an intimate knowledge of general first principles, is essential to determine this in a judicious manner. But we consider it quite possible to attain to absolute unanimity in regard to the system of pruning that is to be adopted; and, in fact, we would almost say that the Scottish Arboricultural Society has but very inadequately fulfilled her mission so long as there exist so many conflicting opinions in regard to this subject.

An impartial inquiry into the advantages of the different methods of pruning will doubtless be well calculated to assist in arriving at the best system. By testing the one system against the other, we may find how far each can be applied judiciously and successfully to the various peculiarities of individual trees, so as to best bring about the fundamental object of pruning, which is the ornamental appearance, or the production of the greatest amount of thoroughly sound and clean timber. By thus as it were comparing the capabilities and the results of the application of the one system with the other, we may be able to discover which is most conducive to the direction of the nutritive energies of the tree, so that the greatest proportion of the nutriment will be appropriated to the elongation and increase of the circumference of the stem, rather than to the production of contending leaders and strong side branches. If this be (as it doubtless is) the primary object of pruning, then the great art of the pruner is to prevent the formation of these overstrong side branches, and by timely checking to restrain and control them, so that they may become subservient to the extension of the stem, and be made to contribute to the growth and production of a sound bole of timber, and

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not be left to increase their own growth to an extent that will be prejudicial to the tree. In order that any system of pruning may contribute in the highest possible degree to the attainment of the fundamental object, it is absolutely necessary that it be in harmony with the laws of vegetable physiology; and it is only by having an intimate knowledge of the structure and functions of the different organs of trees, that any method of pruning can be founded on sound and definite first principles.

In trees, as in all other plants, the nutritive organs are the roots, the stem (with the branches), and the leaves. The sap, which is imbibed by the spongioles at the extremities of the roots, ascends the trunk, and enters the branches, at last reaching the leaves, where it combines with the sap which is absorbed from the atmosphere through the pores of the leaves; and here the leaves transpire all the fluids that are not essential to vegetation, and it is through their instrumentality that the sap is elaborated and changed into the nutritive food of the plant.

Having given the above statement in regard to the ascension of the sap and the uses of the leaf, we now proceed to compare the system of severe close pruning (*i.e.*, clearing off a great number of the branches from the stem without doing anything to check the growth of contending tops) with the system of foreshortening. The leaves being part of the vital energies of the tree, it follows that to cut off the greater part of the branches and the leaves is just removing a number of the most essential organs, and thereby diminishing the rate of growth to a considerable extent. Close pruning utterly fails in bringing about the object in view, namely, the production of the greatest quantity of sound and clean timber,—

1*st*, Because it tends to reduce the vital energies of the tree.

2*d*, It does not check the growth of contending leaders or overstrong side branches, nor prevent them from appropriating the nutriment to increase their own growth rather than that of the stem.

3*d*, It tends to deteriorate the quality of the timber; for when the wounds made on the stem are greater than can be healed over during the first or second season's growth, the exposed surface gradually becomes less succulent, and ultimately loses its vitality before it can be healed over. When this is the case, the wounds may be healed over, but no union can take place between the decaying surface and the enclosing sapwood; and this must unquestionably cause a blemish, if not a serious defect, in the quality of the timber. And, again, the healing of these wounds is an additional

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tax on the energies of the tree, which have already been considerably impaired by the removal of so many of the leaves.

The system of foreshortening has many advantages over close pruning:—

1*st*, The growing energies of the tree are not weakened to any great extent. When foreshortening is judiciously performed, there is so little of the branch removed that the loss is scarcely ever felt by the tree.

2*d*, It prevents a waste of energy, and keeps the branches from diverting too much of the nutritive food from the stem. When a judicious method of foreshortening is carried on with due caution and discrimination, and in a timely and progressive manner, it prevents rival leaders and strong side branches from increasing their own strength, so as to detract from the growth of the stem; and it also keeps the tree to one leading shoot (or top), and that shoot in supremacy of all the others; and thus the main stem is enabled to appropriate the greatest proportion of the nutritive food for its own increase. Another aspect in which this system has considerable advantages over severe close pruning, is in the rearing of trees for the combined purposes of ornament and profit. The trees can be reared under this system with a natural and shapely though not formal appearance (unless it be desired). Close pruning clears the stem, but it makes the tree bare and unsightly, and does nothing to check the growth of rival leaders, or to prevent the tree from being dismembered by heavy, ill-placed branches breaking off during a storm.

In order to prove the suitableness of foreshortening for this purpose as compared with close pruning, we may report the following as an example:—Some years ago a gentleman asked us to inspect the plantations on his estate, and report our opinion regarding them. We found that he was specially anxious about the condition of an ornamental plantation through which the principal drive to his mansion-house passed. This plantation was composed of oaks, elms, limes, and horse-chestnuts, with firs for nurses,—except at the sides of the drive, where, as the proprietor was anxious to form an avenue of lime trees, the ground had been planted with these trees from 9 to 12 feet apart, without any nurses. These trees were about 14 years planted, of a branchy habit and a vigorous growth; most of them had several contending tops. A year previous to our visit, the forester was instructed to prune these trees for the first time. This man understood no other method but close pruning. Accord-

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ingly, he started to clear the branches off the stem to nearly a half of its entire height. There were only a few trees pruned when the proprietor saw the bare and unsightly appearance that they had, and at once advised the forester to stop. In the month of May we sent a suitable man to prune the trees after the following method. Wherever there were two or more contending tops, he was to select the straightest and best as the leader, and shorten all the others by cutting off about a fourth part of their length, and slightly check the strong side branches, always paying the most particular attention to cut over neatly by a branchlet, that would have a tendency to hide the cut, and be inclined to take a horizontal rather than a vertical direction of growth. The pruning was not to be severely done, and no branches were cut off close by the stem. Two years after this they were again slightly pruned, and *one* or *two* of the branches on the lower part of the stem cut clean off, and the wounds made then were nearly healed over during the first season's growth. Ever since, the same method has been carried out with those trees that required to be pruned, and regular attention has been paid to keep the leading top of each tree in the ascendancy of all others, and to make sure that the vigour of the tree was not impaired. These trees have thriven vigorously, and have now a natural and stately appearance, while the few that were close pruned are only recovering from the severe check that they sustained, and thus they exhibit the advantages of foreshortening.

Foreshortening has also peculiar advantages over close pruning in treating neglected hardwood plantations. We have had several instances of success by treating them in the following manner:— By first selecting the trees most suitable for the permanent crop, they were slightly pruned, shortening any strong branch that was wide spread or like to take a vertical direction of growth, and reducing all rival leaders to about three-fourths of their length, in some instances just a mere point being cut off. In two or three years this treatment is again repeated, endeavouring to bring the tree a little into shape and to keep it to one leading top. If at all possible, we remove no branches close by the stem till the trees are fairly recovered from the effects of their neglect. In 1860 we had occasion to prune a few acres of oaks twenty years planted, and the above was exactly the method of treatment that we adopted. Some years previously this plantation had been overthinned, consequently many of the oaks were of a rather branchy habit. But the cautious method of foreshortening gave them a shapely

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appearance without causing any visible check to their growth. It was very different with a part of this same plantation that had been close pruned the previous year. The trees that were thus operated on received such a severe check to their growth that they made little progress, and for some years had such a stunted, unsightly appearance, that it was thought most profitable to cut them down; the situation being a little exposed, there was small chance of their ever becoming healthy, good-looking trees. The original object of the proprietor in planting was chiefly ornament and shelter. The acorns from which these trees were raised he had gathered with his own hands in another country, and all along he had been interested in their progress; but in the case of those that were close pruned, his object was utterly frustrated.

Another example, almost parallel to the above, came under our observation four years afterwards. In this case the close pruning had been performed under the supervision of two foresters. The plantation consisted chiefly of oaks twenty years planted, and the most thriving part had been operated on by No. 1 forester in a most barbarous manner. The branches had been chopped off with a light axe, and the bark on the stem had been much slashed by the axe after it had passed through the branch. In fact, a more ruthless case of close pruning never came under our observation—what with a little caution might have been fine oaks, were actually left with only three side branches, and some but two. This severe treatment had been performed three years previous to the time when we saw them, and they had not during that time made much progress, except the growth of some dwarfish spray on the bare stems. No. 2 forester came, and two years afterwards pruned another portion of this same plantation. His system was a little more refined when clearing the stem. Any very strong upright growing branch that came in his way he did not cut off, but cleared off the branchlets from it to the same height as he did on the main stem, namely, about three-fourths of the stem bared. It is almost needless to say that this method also reduced the vital energies of the tree, and checked its rate of growth to a great extent. These portions, after being left for seven and five years respectively, and making but little progress, were cut down, and the bark peeled and cured; but we found many of the trees so deficient in circulating sap, that it was impossible to get the bark *profitably* taken off. Altogether it was a bad quality of bark. The exterior was rough; and, though carefully dried, the inner bark contained but little astringent matter.

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A year after the second portion of this plantation was pruned, a number of oaks grown under similar conditions, and about the same age (in fact, growing about 500 yards' distance from these), were foreshortened, and a few branches were cautiously from time to time removed from the stem; and these oaks are now worthy of being termed naturally handsome and thriving trees.

There is yet another instance in which the two methods can be contrasted, namely, in the rearing of trees in a nursery for the purpose of planting them out as hedge-rows or in the park. By foreshortening we get a *stout* well-proportioned stem, able to overcome the effects of transplanting and withstand the influence of the wind; while by the other we get a slender, weakly stem that makes but little progress for a few years after being planted out. For example, some years since, when planting a row of lime trees (from 6 to 8 feet high) on the side of a drive, we found ourselves short of a sufficient number of home-reared trees, and wrote to a very respectable nurseryman to supply us. He replied, stating that the trees he had of that size were bought in and were barer in the stem than he would have liked, but he could get no other. As soon as they came, we at once saw that they had been very much overpruned. There were several wounds on their slender stems, scarcely healed over. Seeing this, we planted them very carefully, causing a portion of leaf mould to be mixed with the soil from each pit. Notwithstanding, the home-reared trees that had been foreshortened made more progress the first season than the others did in four, and the latter still have a very bare appearance.

We come now to compare the advantages of nature's pruning with foreshortening. Some years since a number of articles appeared in the "Scottish Farmer," that were apparently written by a *theorist*. He denounced pruning totally and vehemently, as unfit to be practised. But notwithstanding all that was then written, it can be easily shown that the actual evils of pruning have originated from the abuse of the practice, and the mistaken use of it, as in the case of excessive close pruning. But beyond the *overdoing* or the *undue repetition* of foreshortening, all other disadvantages are entirely imaginary. No real bad effects whatever can be fairly chargeable against *judicious foreshortening*, when conducted on sound principles, except it be the incidental ones of its affording those who are *uninitiated* in the first principles, or unpractised in the art of foreshortening, a temptation of overdoing, and thereby maltreating, trees. It is, we think, the enormous mischiefs that have attended

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and followed the practice of severe close pruning that have led some writers to speak currently against the practice of any pruning whatever. But the bad effects must be charged against a faulty method, and not against every system of pruning. There are several disadvantages that follow the entire absence of pruning, and some think, that in the case of rearing hardwood trees with nurses, these disadvantages can be obviated by proper attention to thinning. But in our opinion it is impracticable to rear a crop of hardwood trees as judiciously and *profitably* by merely thinning, as when attention is paid to check rival leaders and strong side branches. Delaying the removal of any one of the nurses may cause the decay of a number of the side branches, but it cannot arrest the progress of a contending leader; on the contrary, it tends to encourage it. When thinning is unduly delayed, the nurses have a tendency to force the side branches to grow upwards; and thus ill-placed limbs and double tops are formed. And it also makes a bare, slender stem, by causing the branches to decay and fall off, generally leaving a piece of decayed stump on the trunk of the tree. Nature at once of herself endeavours to remove these, and unaided she will effect it, but not certainly without causing a greater defect in the timber than sawing off the stumps would do. Nature carries on the amputation and healing-over process at the same time; and the new collapsing sapwood, in endeavouring to accomplish this, encloses a portion of the decayed branch. Thus a protuberance is produced, and the piece of decayed branch that is enclosed will, beyond all question, cause a flaw in the timber.

Recently the following example came under our notice:—Two plantations, consisting chiefly of ash and elm, were thinned at one time. Though on different estates, these plantations were adjacent to each other, and the age, soil, situation of both were alike; but the method of rearing had been very different. No. 1 had been occasionally pruned and regularly thinned, and the "root-cuts" of the trees that were taken from it at this time sold readily at 1s. 6d. per foot in the plantation. No. 2 plantation had been utterly neglected in pruning, and the thinning had not been timeously performed, and the root-cuts of the trees sold with difficulty, after being *carted to the road*, at 1s. 1d. per foot. "The tops" or second quality of timber in both plantations were sold to the same wood merchant at 12s. per ton delivered. He cut them into barrel staves, and kept the produce of each plantation separate. At the time of sawing, No. 1 plantation produced more staves per ton of rough timber than No. 2 did. After the staves

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were dried, they were sold, and about one-fourth of those cut from No. 2 were rejected, and disposed of at less money, owing, as the wood merchant said, to the "black knots falling out of them;" and that these were pieces of decayed branches that had been enclosed during the growth of the tree there can be no doubt. We went and compared the staves together, and found that there was scarce a flaw in those cut from No. 1 plantation, while many of the others were much discoloured, and in some of them there were holes about a half-inch in diameter, from which the pieces of decayed branches had fallen. An examination of the trees showed the same results; many of the trees in No. 2 were partially covered with tumours, and the timber of many had a blackish appearance to the very root. And there can be no doubt that this was caused by the admission of water through the cavities that had been formed by the fall of decayed branches. In this instance, the attempt to produce a *clean* but *sound* bole of timber, by delaying thinning until, from confinement, the branches had decayed and fallen from the stem, and so rendered pruning unnecessary, proved abortive. The method of treatment followed in rearing these plantations was very different, and so was the quality of timber produced. The best timber, and therefore the most profitable crop, was produced by No. 1, which had been reared under a moderate system of pruning, when in its most rapid state of growth.

These examples prove the inadequacy of nature's pruning to produce a sound bole of timber; and they also, we think, show that timely foreshortening would frequently prevent the decay of branches, and thus avert the formation of cavities in the stems of the trees. It is well known that severe thinning produces a coarse, branchy stem; for, unless they be pruned, there is nothing to prevent the branches from having their own way without restraint, and they thus absorb too much of the nourishment from the stem. These branches are frequently improperly attached to the trunk; and being heavy, they often splinter off, and thereby destroy the ornamental appearance of the tree, and deteriorate the value of its timber. Trees brought up under these conditions are generally short in the stem, with large wide-spread heads, that occupy more space than if they were reared under a proper system of pruning and thinning. Judicious foreshortening enables the trees to economise space and the benefits of the atmosphere: timely checking of rival shoots and strong side branches restrains the natural bent of the tree, and thus they are kept within due bounds, without being

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subjected to an over-reduction of the vital functions. Each individual tree is enabled to participate in the advantages that are to be derived from equal exposure to the influences of solar light and heat. Brought up under these conditions, there is a sufficiency of light admitted equally all round each tree; consequently they will grow faster, and for a much greater length of time, without unduly pressing on each other, than if left without any pruning whatever. Four years since an ornamental plantation, composed chiefly of lime trees, horse chestnuts, sycamores, and maples, planted about 9 feet apart, came under our observation. They had been ten years planted; and as it was the intention of the party who was entrusted with the rearing of these trees to produce an ornamental tree *without any pruning whatever*, not a branch had been touched. Consequently most of the trees had several contending tops, and the whole of them were of a wide-spread and very branchy habit; so much so, that many of them were pressing on each other. These trees were cautiously foreshortened in 1869, and in the springs of 1870 and 1871 they received a slight pruning, just sufficient to keep them to one leading top, and restrain the strongest of the side branches, so that they might be very gradually brought into a shapely, but natural and ornamental appearance. This has now been to a great extent accomplished, and the trees all the time kept in a rapid growing state; and if they are now judiciously cared for, it will be some years before any thinning is required. And we are much deceived if they do not ultimately become very stately and ornamental trees. Believing that the idea of rearing these trees, whether for ornament or profit, without any pruning whatever, was utterly absurd, and wishing to prove it, we left a few unpruned, and as yet they have made little progress in the way of becoming anything like trees; in fact, we anticipate that they will become nothing more than huge bushes, unsightly in appearance and unprofitable as a crop. We might give more examples illustrative of the defectiveness of nature's pruning as compared with foreshortening; but we forbear, believing that we have said sufficient to prove the advantages of foreshortening. And to show that when this system of pruning is adopted in preference to nature's, those evils that alike follow over-crowding and over-thinning are averted.

We have yet to consider the method of "snag pruning"—*i.e.*, cutting over the branch from a few inches to about a foot from the stem. The effects of this method on the energies of the tree are similar to those that follow close pruning, the rate of growth is

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diminished, and nothing done to prevent the growth of rival tops. The leaving of this stump is no advantage whatever; it becomes an incumbrance to the tree similar to what a decayed branch would be, and its effects on the quality of the timber are identical with those we have already described as following nature's pruning. Consequently, we consider it sufficient to say that it has no *real advantages—it lacks the good effects* of foreshortening, and has all the *bad effects* of the method of close pruning, as also those of nature's pruning.

Another advantage of foreshortening is, that it can be applied to *Coniferæ*, in the form of pinching or disbudding. This very often secures a suitable leading top for those trees that have lost their leader by accident or otherwise. We can point to several examples where, by a little attention, good leading shoots have been produced by pinching back the upper tier of lateral branches *except one*. When this is done, nature comes to our aid, and gradually, as the branch grows, she turns it in an upward direction, until it becomes vertical. This is often done with such a nicety, that in a year or two the tree has scarcely any appearance of having ever lost its leader. In 1870, a *Pinus Laricio* lost its leading top after it had grown a few inches. We cut this broken top out by the joint, and pinched all the lateral branches on the uppermost tier, except one, which was left as a top, and it grew about 6 inches that season, and in 1871, 24 inches, and gradually came into the place of the leader. This season it has again added 24 inches to its height. We could give similar examples, with specimens of *Picea nobilis*, *Abies Douglasii*, *Pinus excelsa*, and many others that have been brought into a proper form of growth by timely pinching.

In pruning deciduous trees, when we are forced to take a suitable lateral as the leader, nature lends us her aid, and by degrees assists it into the proper form and place. And again, when we shorten a rival top, she comes to our assistance by causing the lateral branches that grow out above the shortened branch (or top) to bend down, and grow in a rather more horizontal direction, and thus, as it were, assist us by overshadowing the shortened leader.

Before concluding this paper, we wish to say that foreshortening can be *overdone*, and we want it to be distinctly understood that we are no advocate for the system of shortening the most of the horizontal branches, and thus, as it were, cropping the head of the tree into a formal or conical shape to please the eye. This ought to be considered a matter of secondary importance, for when it is severely

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carried out it is little better than close pruning. We have seen several instances where it was so much overdone, that the energies of the trees were very much checked. When the branches are too much curtailed at one operation, foreshortening becomes positively detrimental to the health and growth of the tree at any age.

The great art of foreshortening is to shorten only contending leaders, and those side branches that are so strong as to detract from the growth of the stem, to about one-fourth or one-half of their length. In this manner, pruning only those trees that require to be pruned, we go over the plantations every second or third year till the trees have reached to about 30 feet high. When such a system of management is adopted little close pruning is required, as the nutritive energies are directed more to the extension and formation of the main stem than to the growth of the lower side branches. This appropriation of the greatest proportion of nutriment by the main stem has a tendency to keep the side branches slender; and gradually as the tree increases in height, this, combined with the influence of the nurses, causes these branches to become less vigorous. When close pruning is necessary, it should be done sparingly, taking care not to remove too many branches at one time; and before removing any, pay particular attention to the appearance of the tree, to see that it is so abundantly supplied with healthy leaves as to be able to spare one or two of the side branches without its rate of growth being very much checked. And endeavour to make sure that the wounds made on the stem by the removal of these branches is not greater than the tree can heal the first, or at *longest* the second, season. It is during the growing season that pruning can be best performed, as the wounds are begun to be healed up before winter sets in.

Having given the above outline of the method of pruning, we would only add that foreshortening is beyond all question the most advantageous method to adopt wherever pruning is required. And we would recommend every forester to test it for himself by actual experiment, and communicate the result to the Scottish Arboricultural Society, and thus establish a uniform method of pruning based on sound and definite principles.

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VI. *On the Value of the Corsican, Austrian, and Douglas Firs, as timber trees in Great Britain, and on their Adaptation to different Soils and Situations.* By ROBERT HUTCHISON of Carlowrie, F.R.S.E.

Since the outbreak and general spread of the larch disease in many wood-producing districts of the country, by which confidence in that valuable conifer has been shaken, attention has been directed towards finding a substitute, alike rapid in growth, suitable for a variety of situations, of equal durability as a timber-tree, and adapted to a similarly wide range of economical uses.

The three varieties of fir, distinct and widely different in their natures and habits, which form the subject of this paper, have been successively brought under public notice as valuable trees for British culture, and worthy of extensive cultivation. Introduced at different dates, and consequently with a considerable difference of years' experience from which to judge of their respective merits, as worthy successors to the fine old larchwood of which the country could formerly boast, there can be no doubt that all three have proved to be well adapted for culture in Great Britain, and also suited to a variety of soils and situations.

The three varieties now under consideration present individually distinct characteristics; and although the Corsican and Austrian pines resemble each other, they are quite distinct species. The *Pinus austriaca* has sometimes been styled "*quasi Corsica*," a name to which it is not entitled, for its distinguishing features from *Pinus Laricio*, or Corsican pine, are observed to be *constant* in the growing state, and when compared as timber in the sawn plank, there is a marked difference. The *Pinus Douglasii*, on the other hand, more nearly resembles the common silver fir (*Picea pectinata*,) in colour of foliage and bark, with somewhat of the habit of the spruce in outline. The comparatively recent introduction of this last-named pine renders it more difficult to speak with certainty of its value as timber, seeing it has not yet been tested as a timber-yielding tree; and where specimens have been cut down, the rapidity of growth in early years prevents such cases being fairly cited as any criterion of what the species may prove, when felled in a ripe state, and with fully developed timber.

Considering, then, the three pines which form the subject of review, we notice first the Austrian pine (*Pinus austriaca*).

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This conifer is generally admitted to have been introduced into this country about the year 1835. Its native habitats are Lower Austria, Styria, Moravia, Corinthia, Transylvania, and the south of Europe generally. It is a most useful variety, whether shelter, timber, or ornament is the object mainly in view in planting. In its young state it is of rapid growth, acquiring in a few years a heavy rounded head, and being rather weak-rooted, like most of the fast growing pines, it is apt to become "*winded*" in exposed situations in rich soil. In fact, an old and *hard-headed* Scotch forester once remarked to us, referring to *Pinus austriaca*,—"Eh, sir! it's hard to keep *her* on her feet, when young, in exposed bits!" This habit of forming a dense, heavy top when young is productive also of another evil, for such a mode of growth must engender the formation and encouragement of many side branches, and so detract from the value and bulk of wood in the trunk. As an ornamental pine, *Pinus austriaca* is undoubtedly a great acquisition; its dark, rich green foliage, its dense head of massive contour, its strong side-shoots, and its rapid rank growth, all contribute to render it a tree of desirable habit for effective purposes; but we fear that when compared *for economic purposes* with the other two species referred to in this paper, it will be found deficient in quality, texture, and durability.

The soil in which *Pinus austriaca* flourishes in its native habitats is a thin cold dry soil, of sandy or gravelly tendency; and in such situations it will thrive admirably, and succeed as a timber tree, much better than in rich alluvial deep soil, although more sheltered. In fact, it appears impatient of mild sheltered positions, preferring those apparently less suitable for the growth of timber. As already stated, it is not so well adapted for situations much exposed to heavy prevailing winds, being weak and shallow-rooted in its younger state, and at the same time densely clothed with close umbrageous foliage, which renders it not unfrequently what might be termed "*top-heavy.*"

In localities suitable for its development, and not exposed to heavy winds, *Pinus austriaca* will attain a greater height than the Scots fir (*P. sylvestris*), and is of equally, if not more, rapid growth. The wood is inclined to coarseness, but is tough and firm in texture, rather knotty, but of more commercial value for country purposes than the timber of equal age of either larch generally or the Scots fir. As compared with the Corsican pine (*P. Laricio*), the growth of the Austrian pine is not more rapid, and it is less suitable for exposed situations. *Pinus austriaca* in habit and value more

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nearly resembles *Pinus Pallasiana*, but both are inferior *as wood* to *Pinus Laricio*. The leaves of the Austrian pine are easily distinguished from those of the Corsican, by their being rather longer, and devoid of the twisted appearance which those of the latter present. As a tree to employ as a nurse in sheltered valleys it is invaluable, owing to its dense head, spreading arms, and rapid growth; and to be cut out when it has not attained full size, it is more valuable than the Scots fir, as it can be profitably used for country purposes at a younger age than almost any other fir. Lamp-black and charcoal of excellent quality can be obtained from its branches, and the thinnings are in its native country much sought after by coopers and carpenters.

We proceed now to consider the Corsican fir (*Pinus Laricio*), and its suitability for general and extended cultivation in this country. This pine was first discovered in dense forest masses in Corsica, whence it was introduced into this country towards the end of the eighteenth century. It has since been found over several countries of Southern Europe, including Spain, Greece, and Italy, and it abounds on the mountain lands of Calabria. In these, its native habitats, it attains to a height of 140 feet, and forms a noble tree of bold, erect, open habit. The wood is extremely resinous, tough, and, although tending to coarseness, not so brittle as Scots fir or Austrian pine of equal age, but is elastic and durable; under the tools of the carpenter, it works smoothly and easily, and is much prized for many outdoor or constructive purposes. Felled when about seventy or eighty years old, the wood is found to be well matured, and of a whitish colour, and brown near the heart.

In this country, the Laricio has been extensively planted during recent years as a timber crop, and since the larch failure, probably this conifer more than any other has been substituted for it. It thrives in almost any soil where the Scots fir or spruce succeeds, but will not attain its full development at the higher altitudes, preferring a rather good deep soil and sheltered situation in its younger stages; for being of very rapid growth and early vigorous habit, like *P. austriaca*, it is apt to form a top rapidly, which the slower formation of roots cannot support during high gales of wind. In this respect, however, it does not equal the Austrian pine, and is materially assisted by its characteristic tendency to throw the vigour of its growth more into the trunk and terminal leader, than to form a dense head or many heavy side branches. Another benefit accruing from this erect or fastigiate habit is the ultimately enhanced

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value of the timber, by its being less knotty and of better texture. In general appearance when young, the *P. Laricio* somewhat resembles the Scots fir of the old Strathspey indigenous type, but it is more open and longer between the tiers of branchlets. Its value as timber is not so superior when the tree is young, for thinnings of *Laricio* are found to be soft, and less durable than *larch*, but *when old* it is reported to be remarkable for its toughness, and it is strongly impregnated with resinous sap. Numerous groups and specimens of the *Laricio* 40 feet in height exist in various parts of the country; and in Perthshire, at 600 feet elevation, in a loamy soil and gravelly subsoil, it proves itself equal to any indigenous fir, resisting alike the gale and winter's storm, and rapidly shooting above contemporary trees of Scots fir, larch, and *austriaca*. It may indeed be described as a tree consisting of the *bole* of larch, with the lateral branchlets and foliage of Scots fir.

One qualification of considerable importance possessed by the *P. Laricio* should not be overlooked—namely, its distastefulness in its young state to hares and rabbits. Without positively asserting that ground vermin will absolutely shun the young Laricio, if mixed with other conifers in a plantation, it may be safely asserted that they will nibble away everything else before they will touch it. An experiment to test this was made some years ago at Tortworth Court in Gloucestershire, where Lord Ducie, of whose interest in arboricultural matters this Society is well aware, planted a young *Laricio* in the centre of a rabbit-warren, and which, until the ground was quite covered with snow, the teeming population of the spot did not touch; and even then, when starving, and naturally less capricious in their bill of fare—after an attempt to consume the young needles of the buds—they abandoned the experiment, and sought some less bitter and astringently resinous food. In like manner, *Pinus Laricio* is less liable than any other pine to suffer from the ravages of insects or such like enemies, which infest and disfigure many of the coniferous family. Although we have said that the *Laricio* exhibits a preference for a deep, good soil, it thrives in almost any other description, if we except soft, spongy, and undrained marshy ground. Being of a deep tap-rooted habit, in such a situation the spongioles of the main radicle get chilled and water-logged, and hence the tree will not succeed. Throughout the country it has within the last thirty years been freely planted in all sorts of soils and elevations, and has been proved to be perfectly hardy, and altogether such a variety as ought

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to be more generally cultivated; for while it is a rapid grower and a handsome tapering tree, it is well calculated for planting in masses, as a crop to produce not only *quantity* within a period of forty years, but quantity *of heavy size*, and timber of excellent quality. Although in its native country it is felled about eighty years old, it may be profitably used at even thirty years. It may be seen luxuriating, and of considerable height, at Dolphinton in Lanarkshire, at an altitude of 900 or 1000 feet above sea-level; and in many other counties in the north of Scotland, specimens of the *P. Laricio* show that it is suited to the climate of Scotland. From the long tap-root of this pine, it is, unless frequently and regularly transplanted when young, somewhat difficult of removal, and when forming plantations small plants should be used, as they will ultimately succeed better than those that have had their tap-roots cut or lacerated when young. The true variety of *Pinus Laricio* was somewhat scarce two or three years ago, and as there are several other varieties which when young closely resemble it, care is requisite to obtain the true kind, where the *Laricio* is desired for ultimate profit and for heavy timber purposes.

The other conifer which, at the outset of this paper, it was proposed to notice, is *Pinus Douglasii*, or *Abies Douglasii* as it is more correctly called. This now well-known tree is probably the most popular of the many excellent introductions of its original and ill-fated discoverer, whose name it so appropriately bears. Its first appearance in Great Britain was about the year 1827, when it was raised from the seeds of cones brought by Douglas from the banks of the Columbia river, where it abounds in immense tracts, covering the lofty hill sides, and appearing near the summits of the Rocky Mountains no larger than a mere bush, and gradually increasing in its proportions until in the valleys and at the foot of the mountain ranges it attains a height of 200 feet, with a straight noble stem fully 10 feet in diameter. It is common also in California, and in Mexico a variety of smaller growth, and with longer leaves of a deeper green colour, is found.

In Scotland, this fir has proved perfectly hardy, of very rapid growth, a most graceful tree for ornamental or park purposes, and a valuable timber producer. It has been planted in every conceivable soil and situation, and adapts itself to almost any description, provided the drainage of the subsoil be porous, so that it does not become "water-logged." It thrives at any elevation, and the only drawback is its tendency to lose its leading shoot in early spring,

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or liability to have it broken over, by any bird alighting upon its sap-surcharged stem. This is, however, in a great measure only of secondary importance, for the rapidity with which the Douglas fir repairs the damage is amazing; and we do not think, unless in very exposed open situations, where it is liable to receive the full force of the west and south winds, which are so prevalent in Scotland, that this tendency should be any detriment to its cultivation. There are many other important qualifications, superior to both the Laricio and Austriaca, which the Douglas fir possesses, and which will, we think, tend ultimately to its being preferred by planters generally. While we can hardly point to a single specimen of either of the two former named pines in this country of 50 or 60 feet in height, we have instances of the Douglas in many places throughout the country of fully that size. At Dropmore, where one of the original seedlings is luxuriating in a naturally poor soil, this noble tree has already attained an altitude of over 100 feet! In many other situations both in England and in Ireland, we find it, not certainly of the immense height of the famous Dropmore tree, but of large *tree* dimensions, and in all varieties of soil, from sandy light porous earth to deep heavy loam and clayey subsoil. For example, we find at Charlesfort, county Meath, Ireland, one plant in a sheltered site, in good soil, which in the spring of this year measured 40 feet high, and 3 feet 3 inches in girth at 3 feet from the ground, and which has during the past eight years increased by no less than 22½ feet! It is now about twenty years of age. In the same situation the *Wellingtonia gigantea*, now 29 feet 6 inches in height, has only increased during the same period 17½ feet; and the Deodar, now 36 feet high, only 14½ feet. The Wellingtonia, it should be added, is 4 feet in girth at 3 feet from the ground. At Balgowan, and Keillor, in Perthshire, at an elevation of 600 feet above sea-level, we find numerous Douglas firs. Mr Thomson, the enterprising proprietor, an enthusiastic arboriculturist, plants them and the Laricio by the thousand even at that elevation, and finds them invariably succeed rapidly and well. The tallest specimen there is in the Keillor Pinetum, where it has attained a height of 57 feet, and a girth of 5¾ feet at 3 feet from the ground. The soil is a good loam on gravelly subsoil; but the situation is not unduly sheltered. It ought, however, to be stated that the altitude of this tree would have been much greater were it not that, equally with the other pines at Keillor and Balgowan, it has suffered occasionally from the damage to its terminal bud and shoot, by black-game and capercailzie alighting upon

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them. This specimen was planted in 1833. . Of the same age we found a magnificent *A. Menziesii*, now 46 feet high and 11 feet 3 inches in girth ; also a *P. monticola* of same age, 46 feet high, and 5 feet 6 inches in girth, and all in the highest state of luxuriance and health. These measurements are given for comparison of the growth of those species with that of the Douglas fir, and we may only further add, that there is also in the same situation a *P. nobilis* planted in 1843 (ten years later), now 50 feet high, and 3 feet 9 inches in circumference. At Minto, in Roxburghshire, in good loam and upon a clayey substratum, the *A. Douglasii* planted twenty years ago is now 36 feet in height, and nearly 3 feet in girth at 4 feet from the ground. At Carlowrie, Linlithgowshire, in deep heavy loam resting on clay, there is also one 25 years of age, and 36 feet in height, standing, however, in a rather exposed position for heavy south-westerly winds, from which it seems to suffer, and it has become "lop-sided." At Belstane, on the top of the Pentlands, and at an elevation of about 900 feet, this pine thrives remarkably well. Planted in 1843, they were three years ago fully 50 feet high, and growing in a very poor cold tilly soil. Many other instances might be cited showing the adaptability of *Abies Douglasii* to all sorts of soils and situations in Scotland. The tree at Raith, near Kirkcaldy, in Fife, planted by Douglas himself, is now a splendid specimen, and grows within the influence of the sea-breeze, though in a somewhat sheltered site ; and inland, on poor soil at Dolphinton, Lanarkshire, at nearly 1000 feet above sea-level, it is thriving in quantities.

When young, the bark of the *Abies Douglasii* is covered with numerous small blisters surcharged with highly aromatic and resinous sap, and breaking one of these in passing through amongst a group of plants quite perfumes the air around. As the tree grows older, the bark becomes dry, and of a greyish and rough appearance, quite different from the younger stages of its growth. The wood is reported to be very durable, tough, elastic, beautifully grained, and susceptible of a high polish. No doubt, the utility and beauty of the fibre of the wood in old specimen sections, point it out as suited for either constructive or decorative purposes ; and the beauty, symmetry, and gracefully branching habit of the dark green-clad branches and side shoots, combined with its rapidity of growth, render it equally well adapted in the live state for either ornament or profitable planting.

Considering, then, the prospective value of the timber of these

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three pines respectively in Great Britain, we are inclined to assign the first rank as a valuable and useful wood of high quality to *A. Douglasii*, as it will to all appearances prove generally suitable for nearly every economic purpose; next may be ranked *P. Laricio*, as a very useful wood also, but coarser in texture and of less quality than the Douglas fir; and to the third place we assign *P. austriaca*, which should rather plant as an effective "massing" tree for park or drive decorative purposes, or for dense cover for background effect in ornamental planting. The timber is more adapted for common local country uses, than for sale as a wood for either useful or decorative household purposes.

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VII. *Report on a Collection of Geological Specimens, with an Outline of the Geological and Arboricultural Features of Buteshire.* By JAMES KAY, Forester, Bute Estate, Rothesay.

As this paper combines two distinct subjects, Geology and Arboriculture, I shall advert to them separately, and give—

1. OUTLINE OF THE GEOLOGY OF BUTESHIRE.

The following are the numbers and names (so far as known to me), with the localities where the specimens accompanying this Report were collected:—

No.	Names.	Where obtained.
1.	Granite,	Roza Burn, Arran.
2.	Granite Crystals,	Globe Hill, ,,
3.	Granite,	Ploverfield, ,,
4.	Junction of Granite and Slate,	Globe Hill, ,,
5.	Slate Rock,	Roza Burn, ,,
6.	Old Red Sandstone,	Auchnagallan, ,,
7.	Barytes,	Glen Sannox, ,,
8.	Old Red Sandstone Conglomerate,	Corrie, ,,
9.	Carboniferous Sandstone,	Brodick, ,,
10.	,, Sandstone,	,, ,,
11.	,, Sandstone,	,, ,,
12.	,, Hematite,	,, ,,
13.	,, Sandstone,	Invercloy, ,,
14.	,, Shale,	Corrie, ,,
15.	,, Stigmaria,	,, ,,
16.	,, Ironstone,	,, ,,
17.	,, Ironstone,	,, ,,
18.	,, Limestone,	,, ,,
19.	,, Limestone,	,, ,,
20.	,, Limestone Coral,	,, ,,
21.	,, Productæ,	,, ,,
22.	,, Productæ,	,, ,,
23.	,, Limestone with Productæ,	,, ,,
24.	,, Conglomerate,	Scriden, ,,
25.	,, Conglomerate,	,, ,,
26.	Claystone Porphyry,	Kilpatrick, ,,
27.	,, ,,	Craig Dubh, ,,

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No.	Names.	Where obtained.	
28.	Claystone,	Lamlash Burn,	Arran
29.	,,	,,	,,
30.	Pitchstone,	,,	,,
31.	Pitchstone Porphyry,	Brodick,	,,
32.	Trap Rock,	Dippin,	,,
33.	,,	,,	,,
34.	,,	Lamlash,	,,
35.	,,	Ascog,	Bute.
36.	Mica Schist,	—	North Bute.
37.	,,	—	,,
38.	,,	—	,,
39.	Felspar,	—	,,
40.	Clay Slate,	—	,,
41.	Greywacke,	—	,,
42.	Columnar Sandstone,	—	South Bute.

Instead of attempting any generalisation of the geology of Buteshire on my own part, I beg to offer a few extracts from Dr Bryce's Work on the Geology of Arran and Bute:—

Island of Bute.—The length of Bute from Garrochhead to Buttock Point is 14¼ miles, and the average breadth about 3 miles. The total area, including Inchmarnock, is 31,835 acres. Three deep depressions or valleys traverse Bute perpendicular to its longer axis, dividing the island into four portions, and marking the boundaries of distinct geological formations. They terminate on either side in bays or indentations of the land, formed here, as in most other cases, at the points of least resistance, the junctions, namely, of dissimilar strata. Those on the east side are the well-known bays of Kames, Rothesay, and Kilcattan. The low tracts in question show no rock *in situ*, but are filled with shingle and alluvial deposits, concealing the junctions, strata of peat, and occasional shell beds. The elevation above the sea-level nowhere exceeds 30 feet; and as this is also very nearly the height of the terrace encircling the island, it appears that when the sea stood at that ancient level, Bute consisted of four islands separated by narrow channels.

The various strata exhibited in Bute are the terminal portions of those great bands of rock, sedimentary and igneous, which extend across the country from sea to sea; mica slate occupies the northern portion, between the Kyles on the north and Kames and Ettrick Bays on the south. The rock has its usual character and aspect, and rises into hills of nearly 1000 feet elevation. The district

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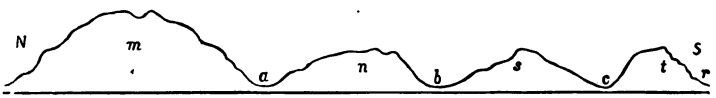
south of this, bounded by the Rothesay valley, consists of the two upper slates, the common clay and chloritic. Subordinate to these are great beds of quartz rock, the most considerable of which forms the high ridge called Barone Hill. The portion extending from Rothesay Valley to Kilcattan is occupied by red sandstone; and finally, the southern portion, with a substratum of red sandstone, consists mainly of various rocks of the trap family, erupted through and overlying the sandstone. The accompanying outline of the island (fig. 1) shows the relation of these strata to the valleys or depressions, which are obviously a part of the system of parallel fractures ranging N.E. and S.W. across Scotland, and probably due to the upheaval of the mountains of the Central Highlands.

The sandstone is in the place of the old red, as succeeding the slates, and has much of the mineral character of this formation in other districts. Along the eastern shore in several places, and again at Kilcattan, beds of limestone occur subordinate to it; but unlike the Arran limestones in the same subordinate positions, they have no fossils containing much siliceous matter, they are of little economic value, and thus have many analogies with the cornstones of the old red, such as occur near the base of Ben Lomond, and in several localities in Arran, the march of Achab Farm, the Fallen Rocks, Glen Loig, and Kilchattan.*

Fig. 1.



a, Kames Bay ; *b*, Rothesay ; *c*, Kilcattan ; *m*, mica slate; *n*, clay and chlorite slates ; *s s*, red sandstone ; *t*, trap ; *r*, the terrace.

The dikes of Bute are composed of greenstone or basalt, and are very numerous, especially on the east coast. They traverse the strata in various directions, and in some cases can be traced for several miles continuously, preserving nearly the same width and direction throughout. The north shore of Bute is classic ground in the history of the glacial beds of Scotland. It was from an examination of the shell beds found here that Mr Smith of Jordanhill was first led to recognise the arctic character of these deposits.

Arran.—The island of Arran is 20½ miles long from N.N.W. to S.S.E., 10½ miles broad, and with the Holy Isle and Pladda

* Professor Geikie considers all the sandstones to be newer than the old red.

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includes an area of 103,953 acres. The number of rock formations, sedimentary and plutonic, which are found within this limited space is truly remarkable, perhaps unparalleled in any tract of like extent on the surface of the globe; while the varied phenomena which they present in their mutual contacts and general relations to one another are of the highest import in theoretical geology.

A line running from the north angle of Brodick Bay almost due west to Iorsa water foot divides the island into two nearly equal portions, strikingly different in their geological structure and in their outward features. The northern half consists of a mass of peaked and rugged granite mountains, intersected by deep wild glens, which diverge from a common centre and open seaward on a narrow belt of low land. This belt forms a terrace marking the ancient sea-level, and is bounded inland by cliffs pierced with caves and otherwise sea-worn.

The southern half of the island consists of a rolling table-land, bleak and unpicturesque inland, but breaking rapidly down seaward into a coast border of great romantic beauty. The general elevation is from 500 to 800 feet, and the irregular ridges which traverse it, most usually in a direction nearly east and west, rise from 1000 to upwards of 1600 feet.

The granite nucleus occupies the central and by far the greater portion of the northern half of the island. The three mountain groups already described, with the glens and valleys penetrating and dividing them, consist entirely of this rock. It is remarkable, however, that at no point does the granite reach the coast. It is everywhere enclosed by a narrow band or framework of clay slate, of the second or dark-coloured variety, which completely encircles the nucleus. On the east side of the granite nucleus, above Corrie, this slate band is extremely narrow. On the western side it is much broader; but the lower micaceous band appears only in patches in the promontories; west of Catacol it is not seen in any great bodies till we pass into Cantire.

The encircling band of clay slate is succeeded on the east and south by a band of Old Red Sandstone, which, like the slate band, is of irregular breadth. It begins to overlie the slate at the Fallen Rocks on the north-east coast, and occupies the shore thence to the march of Achab Farm, half-a-mile north of Corrie. Here it retires inland, the Carboniferous formations taking its place on the shore, crosses in a narrow band to the west of Maoldon, and stretches thence continuously westward, around the border of the slate, to the mouth

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of Muchrie Water. Between this point and Dougrie, near Iorsa water foot, it attains its greatest breadth. A line from the north side of Brodick Bay to Dougrie very nearly marks out its line of junction with the slate.

The southern half of the island, southward of the Old Red Sandstone boundary above defined, that is, from the String Road and valley of Muchrie Water to the south end, is composed of several members of the Carboniferous series, broken through and overlaid by various igneous rocks, chiefly those of the greenstone type. The prevailing rock and substratum of the whole southern plateau is red sandstone, varying from a fine compact structure to that of a coarse conglomerate. A band of this sandstone extends also along the eastern shore northwards to Corrie, and again from the Fallen Rocks northwest to the Scriden, at the northern extremity near the entrance of Loch Ranza. Subordinate to this sandstone are beds of limestone abounding in fossils of true carboniferous types, with beds of shale and coal, in which are found fossil plants and shells such as characterise these strata in the basin of the Clyde.

Arran is extremely rich in rocks of the trapean order; most of the known species occur, and also those numerous varieties by which they graduate into one another. They form great overlying masses, capping the sandstone of the southern plateau, and rising into the highest hills of this division of the island. They are interposed amid the sedimentary deposits, in huge sheets or beds conformable to the stratification, and cut through all the rocks alike, from the lowest to the highest in vertical or slightly inclined dikes, which range continuously across great horizontal distances.

The trap rocks of Arran may be arranged in three classes, according to their composition:—The Felspathic, comprising porphyry, claystone, compact felspar, and pitchstone; the Hornblendic, as diorite and amygdaloid; the Augitic, as basalt and dolerite.

Great Cumbrae.—This island is three miles long, and one and a-half broad. The surface rises gently towards the middle, and the height nowhere exceeds 500 feet; the southern shore presents some low rocky cliffs; on the other sides the ground descends by grassy slopes and sandstone ledges. Great Cumbrae corresponds in geological structure with the middle region of Bute, and consists of red sandstone having a slight northerly dip, traversed by numerous trap dikes, invaded by sheets of the same rock, but not overlaid by trap except in one spot on the west coast, where a small patch occurs. The sandstone is generally of a deep red colour, almost the only ex-

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ception being found in the small islets forming the harbour of Millport, which consists of white and grey sandstone. Strata of conglomerate structure are occasionally met with; and the ridges on the west formerly showed some thin limestone beds interstratified with sandstone, but these have been worked out. No fossils have been met with; but there can be little doubt that the sandstone is of the same age as that of South Bute, most probably lower carboniferous.

Little Cumbrae.—The Lesser Cumbrae is about two miles long and one mile broad, and in its bolder outlines strongly contrasts with the sister isle; its highest point has an elevation of about 800 feet. In geological structure and in altitude it corresponds with the southern division of Bute.

Pladda.—This islet is attached to Arran by a whin dike, over most parts of which there is broken water at low tide. The island consists almost wholly of a dark-coloured trap rock, the sandstone foundation appearing only on the north-eastern shore.

II. Arboricultural Features of Buteshire.

Island of Bute.—The extent of enclosed plantations in Bute is about 1600 acres. The principal portion is the policy woods of Mount Stuart, the remainder being a number of detached belts and plantations in the south and north parts of the island.

The plantations to the south of Rothesay rest on the carboniferous formation, those to the north on the slate formation. Though there is a considerable breadth of trap rock in the middle and south portions of the island, there is no wood of any consequence to afford conclusive evidence of the advantages or disadvantages of such underlying formation to the growth of trees. At the same time, from the character of the herbage, the dry nature of the soil and substratum, caused by the numerous intersects with which the underlying rock abounds, we should suppose that trees would grow well where there is sufficient depth of soil.

The policy woods of Mount Stuart have an elevation of from 10 to 150 feet, with an east exposure, and are completely sheltered from the west storms. The portion immediately round the mansion-house is of considerably older date than the outer portions, in all probability dating back to the commencement of the mansion-house —1712—which gives an age of 160 years. The outer portions average from 30 to 62 years old. The part of the policy woods along the sea-shore rests at the bottom of the old sea terrace, and is very few feet above high-water mark. The rock in a great many

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parts is within less than a foot of the surface. The soil is a deposit of gravel or gravelly soil—the remains of the ancient sea beach—and is damp from imperfect drainage in a great many places. Still the trees have grown remarkably well. Though the surface is naturally flat and damp, yet in long-continued droughts the soil becomes exhausted, as was evidenced four years ago (1868), when several fine spruce firs succumbed for want of nourishment.

The higher portion of the policy woods is principally composed of mixed hardwoods, with a few Scotch, spruce, larch, and silver firs, and stands above the level of the ancient sea-cliff (from 40 to 80 feet above present sea-level). The soil varies from a sandy loam to a gravelly clay. There are some fine trees in this portion of the woods. Spanish chestnut thrives remarkably well, and the lime-tree avenue and beech walk are specially admired. The latter, according to the old fashion, is perfectly straight, and of considerable length, and lies betwixt the cliff and the sea. The beeches are from 100 to 120 feet high, and resemble a vast Gothic arch when viewed from one end. There are also several specimens of rare and beautiful plants in the flower-garden; and such is the mildness of the climate, that exotics, which are raised in few places in Britain, are found here in a vigorous state. Miss Sinclair alleges that they have mistaken Bute for the tropics, and continues:—"Cape heaths flower luxuriantly in the open air, remaining out all winter, as well as standard plants of the *Magnolia grandiflora*, which have risen to the height of 18 or 20 feet. Sweet almonds ripen; geraniums are on fire with scarlet flowers; fuchsias and camellias have been enlisted among the hardy plants; and we observed two thriving cork trees. In short, it seems that that which flowers once a year elsewhere blossoms twice here; and what grows 6 feet high in other places of the empire grows 12 in this more favoured spot."

The outer and detached portions of plantations to the north, south, and west of Mount Stuart are composed principally of larch, Scotch and spruce firs, and have mostly a south or south-west exposure, with an elevation of from 50 to 500 feet. The soil varies from a clayey loam to a thin gravelly till with a rocky bottom (conglomerate). Where the situation is sheltered, with a fair depth of soil and perfect drainage, the trees have generally grown well. Where the situation is exposed to the west winds, the trees are considerably inferior, the larch, more especially along the exposed sides, being much blasted.

The plantations in the northern half of the island rest on the slate

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formation. The greater portion is composed of larch, with a mixture of spruce and Scots firs. Exposure—north and north-west, with an elevation of from 50 to 500 feet. The soil generally very thin; but where the surface is of a loose rocky nature, and the drainage naturally perfect, larch trees grow well, and are generally more healthy than those grown on the carboniferous formations, or south portion of the island.

There are several portions of coppice wood in the middle and north end of the island; but these are of comparatively little value, and the land could be turned to more profitable account if cleared, drained, and planted with larch, Scots and spruce firs. Along Ascog shore, east of Rothesay (carboniferous formation), there is a fine margin of wood along the sea-cliff. There are also several specimens of the rarer coniferæ in the villa gardens here and near Rothesay; and at Kames Castle, North Bute, there are a number of fine old park trees.

Inchmarnock.—This island is of the same formation as North Bute. The soil is of a clayey nature with a tilly bottom. With the exception of a margin of birch and hazel scrubwood along the east side and south end of the island, there is no wood of any note. The small scrub is cut and used as firewood or for fencing purposes by the farmers on the island.

Great Cumbrae.—The wooded portion of this island lies along the east and west sides of the road leading from the south to the north end, and extends to about 90 acres of mixed plantation, 45 years old, with an elevation of from 50 to 184 feet above the sea-level. The greater portion has a south-west exposure, and the soil (except in the hollow parts) is very thin, with a rocky bottom. The Scots and silver firs have grown best. On some of the poor and rocky parts, the larches are not more than 4 inches in diameter. On the best ground the largest Scots and silver firs average 12 to 15 inches in diameter at 5 feet from the ground. In the college grounds near Millport there are a number of fine araucarias, about 14 years old, averaging from 9 to 16 feet in height.

Little Cumbrae.—There is no wood on this island, only a scanty herbage.

Pladda.—This is only a rocky islet.

Arran.—The extent of enclosed plantations on the island of Arran is about 1250 acres, of which 800 acres are from 42 to 60 years old, and 450 acres from 14 to 25 years old. With the exception of a few scattered portions of wood, planted within the last twenty

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years, the greater portion of the enclosed plantations is in the immediate neighbourhood of Brodick Castle. The wood round the castle, with the exception of a part of the wood at the mouth of Glen Roza, which rests on the Old Red Sandstone, is all on the Carboniferous formation. Exposure—east, with an elevation of from 50 to 500 feet.

The wood to the west of the castle is composed of larch, Scots and silver firs, about 45 years old. The soil varies from a peaty soil to a clayey loam, intermixed with freestone and slate shingle, with granite boulders. The Scots firs, though having been pretty close drawn up, are rather coarse grown; and though there are several fine Scots firs in this portion of the plantation, the larches are generally the largest trees and the most thriving. To the north of the castle, along both sides and to the north of Merkland Burn, the wood consists chiefly of oaks, which are not in a thriving state, being much fogged and stunted, which no doubt is much aggravated by the damp state of the ground. To the south of the castle, on north side of Roza Burn, the wood is composed principally of Scots and spruce firs, 42 years old. To the west of this part of the wood is principally larch, with a row of planes on the west or storm side. The trees, though evidencing the effects of the storm at the mouth of Glen Roza (leaning very much to one side), are remarkably healthy:—no dead tops are to be seen. Though there are a number of larch and spruces which measure 15 inches in diameter 5 feet up, the greater proportion would class under the largest size of propwood. On the south side of Roza Burn there is a fine clump of mixed wood; and, with the exception of a few trees in the north-west corner of the plantation, they are equally healthy to the last.

It may be noted that the junction of the Carboniferous and Old Red Sandstone is somewhere near the centre—south and north of this plantation, also through the upper corner of the last-mentioned plantation—on north side of Roza Burn. The junction is not definitely seen, the bottom of the burn being obscured with gravel and granite boulders.

There is also a piece of fine wood, composed principally of larch and Scots fir, with a few silver firs, oak, and beech, about 60 years old, between Brodick church and school-house. The larch and Scots fir average 9 to 16 inches in diameter 5 feet up. Immediately behind the castle there is a plantation, about 25 years old, with a few old Scots fir and silver firs as standards. Several of the silver firs are 120 feet high. There is also a clump of larch about 12

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years old, planted in the centre of the old wood to the west of the castle; but the greater proportion have been destroyed by the deer, which are very numerous here. With the exception of a small portion of wood to the east and west of Invercloy, this comprises the principal portion of the wood round Brodick Castle.

The plantations in the south end of the island have been mostly planted within the last fifteen years. Exposure—south and south-east, with an elevation of from 100 to 500 feet. With the exception of the young plantation at Lag, the larch of which seem to be in an unhealthy and diseased state, they are all remarkably healthy, though much in want of thinning.

At Lamlash and neighbourhood, the glens are more or less fringed with a margin of natural wood, composed of plane, birch, alder, and elder. At White House there are a number of fine silver firs, and some fine shrubs; also, near the north end of Lamlash village there are several fine araucarias, about 15 feet high. Near the shore, along side of the road leading from Lamlash to Brodick, there are a number of beech and Scots firs about 80 years old.

The next to be noticed is a margin of birch coppice-wood, along the sea-cliff from Brodick woods to Glen Sannox, and from Loch Ranza to Dugarry. Hazel is very scarce in most parts. Though the above are the principal localities of the birch or coppice wood, straggling trees are seen more or less in all the glens near the shore in Arran.

On the west side of the island, immediately above the shore, we observed numbers of elder trees more than a foot in diameter.

The only piece of wood of any note on the slate formation is 35 acres of young plantation, 25 years of age, immediately above the shore, at Whitefarland, on the west side of the island, which has an elevation of from 20 to 300 feet, with a full west exposure to the sea. It is composed principally of larch, with a few ash and alder intermixed, with a double row of planes along the shore. Considering the nature of the ground, which is a rough rocky face, and exposed as this plantation is to the storms of the Atlantic, the trees are remarkably healthy. The planes are *very healthy*, averaging 9 inches in diameter 5 feet up. The hills rising immediately behind this plantation must act an important part in warding off the storm from the lower ground.

As evidence of the mildness of the climate on the east side of the island, Dr Landsborough remarks, "that in Cromla garden (near Corrie) the oleander (*Nerium oleander*) stood a winter in the open

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air, without protection of any kind, and flowered well in the greenhouse the following summer. The gorgeous *Rhododendron nobleanum* is in bloom the whole winter; so also is *Genista Atleana*, (5 feet in height). A myrtle, planted out in 1862, now 8½ feet in height, and more in circumference, flowers magnificently every season. This year (1871) there were planted *Cyathea dealbata*, perhaps the most beautiful of tree ferns. An Australian gum tree, and also the beef-wood or she-oak (*Casuarina quadrivalvis*), the most singularly picturesque tree of the Australian flora, being a tree paddock pipe."

I visited Cromla garden in October 1872, that I might see for myself, and beg to testify that the plants, with the exception of the gum trees (*Eucalyptus*), which have been injured in some way, are equal to all that has been stated regarding them, though the garden is now much neglected.

For the sake of comparison, I append the following dimensions of the most noteworthy trees in Buteshire:—

Name.	Where Growing.	Age.	Height.	Circumference at 5 feet.
Ash (common), . .	Mount Stuart	160	...	9 ft. 3 in.
*Ash, "Adam," . .	Rothesay	220	...	17 5
*Ash, "Eve," . . .	do.	...	...	12 0
Beech (common), .	Mount Stuart	160	...	13 0
Birch, ...	do.	...	...	7 6
Oriental Plane, . .	do.	...	...	8 0
Lime Tree, . . .	do.	...	...	10 5
Tulip Tree, . . .	do.	...	...	5 0
Evergreen Oak, . .	do.	160	...	9 6
Hornbeam, . . .	do.	160	...	6 0
Sweet Chestnut, .	do.	160	...	11 9
Oak, ...	do.	160	...	9 6

* "Adam" and "Eve" are two remarkable old ash trees on the roadside, a little to the south of the town of Rothesay. The largest, "Adam," having become much decayed, the trunk completely hollowed out, and only a thin shell of wood and bark on the one side keeping it in life, the largest limbs, some of them 3 feet in diameter, had to be cut off three years ago, to prevent it from being blown down. The first and second year after the limbs were cut off, it gave signs of vigorous life by sending out several shoots from 2 to 3 feet in length; but last year (1871) its race seems to have been run, and it now stands a hollow dead trunk, a monument of former greatness. The age of this tree was ascertained by counting the annual rings of one of the limbs. Most of the wood being perfectly sound, part of it was made into seats, which were placed along the shore to the east of the town. "Eve" is still vigorous and healthy, and likely to be so for many years. We have no means of knowing the age of this tree; but it must be considerably younger than "Adam."

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Name.	Where Growing.	Age.	Height.	Circumference at 5 feet.
Turkey Oak, . . .	Mount Stuart	...	...	7 ft. 1 in.
Cork Oak (*Quercus Suber*), ...	do.	36	20	2 9
Abies Douglasii, .	do.	12	33	...
Abies morinda, . .	do.	36	30	2 5
Araucaria imbricata,	do.	12	9	...
Araucaria imbricata,	do.	15	15½	1 1
Cupressus macrocarpa,	do.	...	26	...
Cedrus Libani, . .	do.	...	60	5 10
Larix europæa, . .	do.	...	...	9 3
Picea pectinata, . .	do.	...	96	12 10
Pinus sylvestris, . .	do.	...	91	8 7
Taxus baccata, . .	do.	...	60	8 4
Wellingtonia gigantea,	do.	13	12	...
Robinia Pseudo-Acacia,	do.	36	43	2 9
Cedrus Deodara, .	do.	36	36	3 0
Cryptomeria Lobbii,	do.	36	33	2 11
Pinus Strobus, . .	do.	...	30	6 0
Araucaria, . . .	Rothesay	18	22	1 10
Araucaria, . . .	Millport	14	16	...
Araucaria, . . .	Brodick Castle	20	24	1 10
Abies morinda, . .	do.	...	14	...
Cedrus Deodara, .	do.	...	20	1 7
Pinus austriaca, .	do.	...	...	8 10
Pinus sylvestris, .	do.	...	...	9 3
Larix europæa, . .	do.	...	...	10 9

Where the age is not known, the column is blank.

Though the foregoing is but an imperfect review of the arboriculture of Buteshire, still it is hoped that it may be worthy of acceptance.

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VIII. *On Different Modes of Profitably Disposing of Home-Grown Timber.* By DAVID TAIT, Forester, Owston Park, Doncaster.

This subject is one well worthy of the attention of landed proprietors and their foresters. As timber is a crop which occupies the ground about sixty years on an average, it is very fitting that we should consider the different methods in use for disposing of it, and choose the one which will bring in the largest return, as the question of woodlands being profitable may be greatly affected by the disposing of the timber crop.

In considering this subject, I have stated the various methods of disposing of timber with which I am acquainted, and have given my opinion on their respective merits, viz. :-

1*st*, Selling standing timber.
2*d*, Selling fallen timber by auction.
3*d*, Do. do. by tender.
4*th*, Do. do. privately.
5*th*, Do. do. in a manufactured state.

The selling of growing timber, which is very general throughout the country, is a common mode of disposal; but is, I believe, more common in England than in Scotland. Its advantages may be described as follows:—*First*, if the bidding at the sale does not reach the reserved valuation, the timber can be left standing, and if in a healthy condition will improve in value; *Secondly*, the sale can be managed at much less expense than if the timber is cut down previous to being sold. When sold in this way the common plan is to go through and number each tree, and put a valuation on it,—all the propwood or small poles being simply marked and counted, and an average taken of what they contain. A reserve price is then made out; and if the intending purchasers do not bid up to that figure, there is no sale till some future time. After the timber is sold, the purchaser sends men into the wood and has the timber cut down and taken off the ground at his own expense, the conditions of sale generally binding him to have it removed before a certain date, otherwise it becomes forfeited to the vendor. Some "conditions" are extremely binding in this respect, others are quite the reverse, and very much to be condemned. For instance, a sale came under my notice a few weeks ago (in Dec. 1871), the time fixed for having the timber off being March 1873.

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A quantity of the wood sold was fast-growing ash, so that besides the damage done to the trees that were to remain, the timber merchant, by letting the timber stand till October 1872, will have several hundred feet of wood more than he had at the time of the sale. I will now state some of the disadvantages of selling timber in this way. When a sale takes place, it is generally in lots valued at from two or three hundred up to several thousand pounds. The higher the value of the lot, the fewer there are who can purchase it, and consequently there is less competition; and it sometimes occurs that there is an understanding among the bidders at a sale which one is to be the purchaser, the others having what they want out of the lot at a certain price; but it may be answered, if the timber brings the reserved valuation, the proprietor will have got its value. To this I would reply, that even the most practical valuer cannot tell within a foot or two what a tree contains; and in large trees the difference is of course greater, and valuators, as a rule, always try rather to keep below than above the exact measure.

If we suppose a fall of timber to be taken down containing 4000 trees, and each of the trees to be 1 foot over the measure calculated to be in it—which would be very near the mark—we have at once 4000 feet of timber, which, valued at 9d. per foot, gives L.150. I consider that to be a very near case. In fact timber-merchants consider their servants have not valued timber properly if a tree when fallen does not yield several feet above what they calculated to be in it. There is a fall of timber being taken down in this neighbourhood at present, where many of the trees are turning out as much as from 12 to 16 feet above the estimated contents. These are all clean grown beech, worth 1s. per foot.

Another great disadvantage of this method is, the letting strange men into the plantation to cut down the timber. I know it is argued by some that this is no disadvantage, as it can be arranged that the proprietor's men shall cut down the timber; but if this is to be done at the proprietor's expense, it should be done previous to being sold; and if at the timber-merchant's expense, the workmen become his servants for the time being.

The common practice with timber-merchants is to engage men to do the work at so much per 100 feet, and the greatest carelessness is the result. I have always found that men working in this way break other trees to any extent, before they would take the trouble of lopping the one they are engaged in cutting down. Then there is the drawing out of the trees with horses. In this

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operation much damage is often done by carelessness, the men who are doing the work having no interest in being careful. The result is, that many trees get barked to an extent from which they never recover.

I have heard gentlemen who have had large experience in the management of estates, argue greatly in favour of this method of selling timber; but I have never found any practical forester, or wood manager, declare that it was the most satisfactory way of doing the work committed to their charge. The reason it finds favour with estate agents and factors may generally be traced to the cheapness whereby sales conducted in this way can be effected; an argument which should be sufficiently answered by taking into consideration the fact that timber-merchants have generally to pay a higher rate of wages for felling, &c., than landed proprietors are able to do it for; and it is very clear that the expense of such work must be made up in some way.

There are cases where this may be the best way of disposing of a lot of timber. For instance, if it is growing on an outlying estate, where there is not a regular staff of workmen kept, or where there is a difficulty in obtaining the necessary funds for carrying out the work. When it is thought best to sell standing timber, I should recommend selling by tender, for reasons mentioned under that heading.

Selling felled timber by auction.—This is a method of disposing of timber which is pretty general in most parts of Scotland, and occasionally in England; and I consider it by far the most profitable way of disposing of timber. No doubt it is more expensive in the first place; but my opinion is that, when properly managed, it more than repays all expenses in the end.

I have always found this way of disposing of timber gives more satisfaction both to a proprietor and forester, the only objectors to it being extensive timber-merchants.

I offer the following reasons for giving preference to this method:—

1*st*, In this way trees can be felled much more satisfactorily, being done by the proprietor's own men.

2*d*, Timber can be properly classed, and sold in lots to suit purchasers.

3*d*, By selling it in small lots, greater competition is created, and a higher price generally realised.

4*th*, Being divided among several purchasers, it can be sooner removed off the ground.

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On the first reason it is not necessary to make many remarks, as every one acquainted with the matter knows that men who are constantly employed on an estate take an interest in doing their work as well as they can, for the sake of their own character; while timber-merchants' men attend only to their masters' view of the matter; and the only interest they generally show, is in dressing off the end of the tree they have cut down, not caring if, in doing so, they severely injure several other trees.

The second reason stated above speaks strongly in favour of this mode of disposing of timber, as *classing* is what may be called the vital point in this part of a forester's business. There are many different trades carried on, requiring different classes of timber. If a large mixed lot is sold, it is not a consumer, but a dealer, who becomes the purchaser, who then sells it out to different parties as their various wants require. Now by classing the timber and selling it in small lots, this third party is done away with, and different consumers can come forward and buy what suits their purpose. In support of the foregoing statement, I may mention a case that came under my notice a short time ago. The lot offered for sale was mostly plane or sycamore trees, and was exposed for sale by tender. Three timber-merchants gave in offers for it, the highest being L.30; but as that was considerably under the reserved valuation, the timber was kept and sold by auction some time afterwards, when a manufacturer of sycamore furniture being present, it was knocked down to him at L.46. The same party who offered by tender L.30, offered L.45 at the auction sale.

As regards the third reason given above, it is clear that if a lot of timber is sold worth L.1000, the number of people who can make the purchase is very much smaller than if the same quantity of timber was exposed for sale in a hundred separate lots. The class of purchasers who are able to purchase the smaller lots have, where large quantities only are sold, to purchase at a greatly increased price from the larger buyers.

The fourth reason I have given for preferring this method of disposing of timber is of some consequence on estates where the proprietor is in favour of preserving game, as in that case it is a nuisance to have carters coming into the woods to lift timber at certain seasons; therefore, by having say twelve purchasers, the timber can be much sooner removed than if there was only one purchaser for the same quantity.

On the estate where I am at present, the timber was formerly

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sold standing in one lot; but not proving satisfactory, it has lately been sold by auction in small lots, after being cut down; and since that method was adopted, we have had coal-pit proprietors, contractors, bobbin-makers, boat-builders, pianoforte-makers, mill-owners, &c., attending our sales, and buying what suited their various wants.

To give an idea of the cost of felling and putting the timber into lots, I give a statement of what was paid here this year for that work:—

16,172 feet of timber realised, ...				L.727	0 0
Topwood, ...				23	0 0
				L.750	0 0
Cost of felling, . . .	L.50	10	0		
Cost of putting into lots, including horse hire, ...	19	18	6		
Cost of cutting out topwood, .	5	7	6		
Cost of lotting do. .	3	13	6		
Deduct				79	9 6
Profit,				L.670	10 6

The above quantity of timber was sold in 112 lots. In carrying out the sale, I had every tree measured exactly as it was cut down, and the contents marked on the end of the tree; and afterwards, when they were put in lots, I was enabled to get the exact contents of each lot by copying it off the trees as they were brought forward. I had different sorts and qualities kept in separate lots, the size of a lot varying from 100 to 1200 feet.

No doubt the sum of L.80 looks a large amount to pay for labour, but it would have been impossible for timber-merchants to do it so cheaply; and although there is no way of knowing exactly what the difference would have been had the timber been sold standing, yet, from previous experience, I have no hesitation in saying that we would have got for it much less than the net profit realised.

I will now make a few remarks on the selling of timber by tender. In certain cases I highly approve of this mode of disposing of timber. For instance, if it is a quantity of oak, or Scotch fir, or any other lot of timber of one class; but I certainly do not recommend it where a mixed lot is to be disposed of, as all the advantages which I hold are to be gained from classing the timber are entirely lost.

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One great advantage of this method is the cheapness with which a sale may be effected. Of course, I recommend it to be cut down previous to being sold; but where it is desirable to sell a lot of timber standing, I recommend tender instead of auction sale. When sold in this way, the plan generally adopted is to inform the timber-merchants who are likely to become purchasers by circular of the number of trees and quality of timber to be disposed of, and the date by which the offers must be sent in, said offers to be in accordance with conditions of sale specified; and as none but timber-merchants of good standing would be informed of the sale, the highest offerer should become the purchaser, upon agreeing to and signing the conditions mentioned.

Selling Timber Privately.—This mode of selling timber—although adopted on some estates for disposing of large quantities of timber, both standing and fallen—is only suited for supplying a local dealer with a few trees (by privately I mean where only one merchant is invited to become purchaser). As competition is the life of trade, I prefer it in every instance where it can be brought into play. And if a lot of timber reaches the value of L.20, I should certainly say, sell it by tender. When there are only a few trees to be sold, they should be cut down and measured, the market price per foot being charged for them.

Selling Timber in a Manufactured State.—On some estates there is a saw-mill, at which timber is cut up into boards, palings, stobs, pit-props, gate-posts, &c., and sold. Some people recommend this method as a profitable way of disposing of inferior lots of wood; but I think there are stronger reasons against than in favour of it. For instance, to keep the saw-mill going, some trees are very likely to be cut down and sawn up that ought to have been left growing; besides, I have no doubt the extra money got for the wood is spent in manufacturing it, as there are not the appliances or division of labour to work with that are found in an establishment fitted up for that particular trade. I am certainly of opinion that on every large estate there ought to be a saw-mill, especially where water-power is available; but this should be used only to cut up wood for estate purposes, or to supply the tenants with fencing material at market price.

I have not said anything about "conditions of sale," in regard to any of the methods mentioned, as different districts require different conditions; but care should always be taken not to make *too loose* arrangements about the payment of timber, as many people seem

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to have an idea that timber should almost be given away. Now, as timber is a crop that stands long before giving any return, one would think the very reverse should be the case; yet I am aware of certain districts where there is no difficulty in getting payment in three months from date of sale, or by giving 5 per cent. discount of getting ready money; and still on some estates, in the same district, twelve months' credit, or 10 per cent. discount, is given.

In conclusion, I would say that "the best mode of profitably disposing of timber" is a subject well worthy of more consideration than it generally (or at least often) receives.

Perhaps a few remarks on the disposing of forest produce, that does not come under the classification of timber, as well as the different uses it is put to, may be interesting to some of the members of this Society. In some parts of England there is a ready market for hop-poles, rails, hedge-stakes, rods for scarlet runners, pea-stakes, thatch-pegs, and top-wood, made up in faggots or bundles. In Worcestershire ash is grown as coppice-wood, and cut down at about sixteen years' growth for hop-poles, bean-rods, &c., and is generally sold at about L.14 to L.16 per acre, the purchasers doing all the work, and leaving about sixty plants to the acre to grow to a larger size. Every little piece of wood is used up; and, last of all, the small tops, or brushwood, are tied up in faggots, and sold at the rate of 2s. 6d. per score. These are used in all the west and south of England, and throughout Wales, for heating ovens for baking bread, brick ovens being used in that part of the country. As far as has come under my notice, that appears to be about the general price for faggots. In some places the tying up of the faggots is let by contract, the price paid being about 8d. per score; and in some parts of Wales I have known arrangements made with a dealer who paid 3s. for every 100 bundles he tied up, himself finding men to do all the labour. This, however, was within three miles of a coal pit. In the same neighbourhood rails, net-stakes, &c., are sold at 1d. per yard. In Yorkshire small rods, ½ an inch in diameter and 3 feet long, are sold at 6d. per 100, and are used by farmers in thatching stacks. Stronger rods, and 8 feet long, are used for scarlet runners to climb up, and sell readily at 6d. per score. The same class of rods also sells readily to crate-makers, and picked rods about the same size are sought after by skip-makers, for which a better price can be got. (Skips are a sort of crate, used at manufactories for packing the finer sorts of cloth in.) Hedge-stakes are

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sold at 8d. per score, and are about 2 inches in diameter and 5 feet long; net-stakes, which are straighter and stronger, sell at 18d. per score; rails sell about 1d. per yard, and may be described as a size less than pit prop-wood. Small wood tied up in faggots is unsaleable in that part of the country, no brick ovens being used. There is a partial call for the small top-wood at 1s. per cart-load. No doubt in future the increased price of coal will create a greater demand for all sorts of firewood throughout the country.

In Scotland there is little demand for small top-wood, which is either burned up or left for game cover. There is also little done in the way of disposing of the rods cut up in brushing a plantation, although there are some exceptions. On some estates I have known pea-stakes sold at timber sales by auction. I have also known rods for crate making being sent a distance of forty miles at a remunerative price. There is no doubt that by a little exertion a market might be found for a large quantity of such produce as above described, at least on estates situated near a railway station, within thirty or forty miles of a manufacturing town.

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IX. *On the most certain Method of getting rid of Beetles which affect Coniferæ.* By WILLIAM TIVENDALE, Forester, Houston, Paisley.

In the spring of 1865, I was requested by a landed proprietor to look at three young plantations which were very much damaged by the ravages of insects, and to suggest if anything could be done to get rid of them.

On inspecting these plantations, I found that the trees had been three years planted, on ground previously occupied by a crop of trees, principally Scotch pine, and that the insects which had done so much damage to the trees were the wood beetles—*Hylobius abietis* of Germar, and *Hylurgus piniperda* of Fabricius, two of the most destructive pests that arboriculturists have to contend with.

The number of trees destroyed by these beetles exceeded 140,000. In tract No. 1, extent 16 acres, planted with Scotch and Austrian pines, larch, and a few spruce and silver firs, at 3 feet apart, more than half of the trees were completely destroyed; in tract No. 2, extent 13 acres, planted at 3 feet apart, with Scotch pine, larch, and a few spruce, more than two-thirds were rendered useless; and in tract No. 3, extent 14½ acres, not a living plant was seen, save about a dozen of larches in a corner of the plantation which was a little damp, and even these were injured to such an extent that they did not look likely to live over the summer.

On reporting this state of matters to the proprietor, he expressed his determination to get rid of the pests, if possible, in No. 1 and No. 2 plantations; but, as there were no plants in No. 3 worth saving, he put cattle in to graze for a year or two, to see if that would tend to diminish the evil.

Hylobius abietis is ½ inch long, ⅛ inch in circumference, of a bright grey colour, and beautifully spotted over the cases of the wings. It makes its depredations upon all sorts of Coniferæ, but the Scotch pine is, doubtless, its favourite. In its attack upon the tree, it generally begins immediately above the surface of the ground, and eats greedily the bark all round, and gradually upwards, leaving the trees peeled into the alburnum, when they soon die. In the case of older trees, it makes no attempt to eat the rough bark on the bole, but seeks its way to the branches, and preys upon their tender bark. Here it does not eat the bark all round as it does on the stems of the young tree, but makes an attack here and there on the upper

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side of the branch, and seldom, if ever, makes a second attack at precisely the same place, which is the cause of their being far less injurious to large than to small trees. I find that the wounds they make in the bark of the branch soon heals, leaving the tree little the worse.

Hylurgus piniperda is a small dark-coloured beetle, $\frac{2}{16}$ inch long, and about $\frac{1}{16}$ inch in diameter. It attacks the young trees in the same way as I have described, but upon older trees it has a different mode of working. It bores into the centre of the last formed terminal shoot, eats through the pith, seldom making its exit till it has arrived at the base of the bud, when it descends in search of another shoot to destroy in the same way; the shoots thus robbed of their pith soon wither, and hang on the tree for months before they drop off. Five years ago, a number of Weymouth pines under my charge were fearfully infested with this insect, fully half of the terminal shoots of the branches were hanging brown, yellow, and sickly by its ravages. I had all the affected shoots cut off with the pole shears, gathered carefully, and burned in a brisk fire. A cure was the result, the trees being now in a vigorous growing state, and apparently none the worse of having had such a quantity of their young shoots cut off.

Having shortly described the two beetles, their modes of operation, and the best method of getting rid of the small beetle upon large trees, I shall now detail our method of getting rid of both kinds of beetles in the young plantations referred to. The first thing I did was to pare off all the grass from 8 to 10 inches round the trees that were not affected, and those that were affected, but likely to recover; this had a considerable tendency to keep the beetles off the trees, and made them easier seen when they were upon them. We then got a few carts of Scots fir branches from a recently thinned plantation, had all the small twigs and the most of the leaves cut off them, then we laid the branches here and there between the plants all over the plantations; the beetles congregated upon and under the branches, and preyed upon them with voracious avidity; a number of boys were set to gather the beetles off the trees and the branches. Each boy was supplied with a small glass phial, suspended by a cord from a button-hole of his jacket to allow the bottle to hang straight while the boy stooped in search of the beetles; each bottle had a wooden stopper. The boys, with a careful old man in charge to see that they did their work properly, searched the branches and trees for the beetles, which preyed in great numbers

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on and under the branches. Not one beetle of either kind was found upon the young trees for fifty that were upon the branches, which had to be lifted with great care, otherwise the beetles would drop from them among the grass and be lost for the time; the beetles were often found lying on their backs when the branch was lifted, so that it was necessary to look where the branch had marked the grass, for even with the utmost care in lifting it some of them quit their hold. I have seen a boy take 7 beetles, large and small, off one branch, or rather stick, about 3½ feet long; the branches are better to be a little heavy, as they lie more firmly on the grass, and more readily arrest the progress of the beetles in search of food. The beetles generally begin their devastations about the middle of April, and carry on the work of destruction till the middle of June; then few are to be found till the beginning of August, when they again become more numerous till about the middle of September, after which there is scarcely one to be found, even in places where they have not been destroyed. I have heard it said that the best time to gather beetles was at 4 A.M., as that was their principal feeding time. In my experience this is not the case. I have looked for them from between 3 and 4 A.M. to between 9 and 10 P.M., and invariably found them most numerous upon the trees and branches from 8 to 11 A.M., and from 4 to 7 P.M., and on wet days they are only found on the under side of the branches. They keep well in the shade both on the trees and the branches when the heat of the sun is strong; they neither like much heat nor much cold.

We gathered the beetles in the two plantations for 5 weeks in the spring, and 3 weeks in the autumn of 1865, and the number destroyed was 15,100. We gathered again in the following spring, when we captured 2300, and in the autumn we only got 100; total, 17,500 beetles. I do not think we collected more than one small beetle for twenty of the large ones. The beetles were counted by the man in charge, at dinner-time and at night. Each boy's gathering was marked in a book; the boys knew this was done, and it made them strive with each other who would gather most. The beetles were counted upon a large flat stone, and after the number was ascertained they were destroyed with a small flat stone. These plantations were beat up with weeping birch, plane, Scotch fir, and larch, in the spring of 1867, and are growing well without any appearance of beetles.

Plantation No. 3, after cattle being in it for three years, had to be cleared of the beetles in the same way as Nos. 1 and 2. They were only gathered one season, however, before planting. Pits were made

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for all the principals, which should be done in all old Scotch fir ground; this plantation, too, is doing well.

When it is desired to plant immediately after a crop of Scots fir is cut down and cleared away, it should be proved whether the ground is in a foul state or not. This can be done by keeping a quantity of the branches when burning up all the brush, and have them spread over the ground in spring, when it will soon be seen if beetles are there, and, if they are, gather them during spring and autumn. Plant during the winter months, pit all the principals, *i.e.*, the hardwood and Scotch firs, and slit the larches, strew a quantity of fresh branches over the ground in the following spring, gather the beetles this year again, and there will be little fear of the plants being afterwards injured. I have planted Scotch fir on ground which had been under a crop of Scotch fir immediately after the trees were cut down and cleared away, and none of the plants were injured by beetles; but this plantation was under the management of an able forester, who always kept his woods in first-class order, and never allowed Scotch fir branches to lie and rot on the ground. As a proof that the decaying branches of Scotch fir trees are not only a harbour for, but the origin of beetles, I will give an instance. Six years ago I lifted as many Scotch firs and spruces, out of a plantation which required thinning for the first time, as was sufficient to plant an acre of ground for a screen; after these were lifted, I thinned the plantation, and in consequence of other estate improvements going on, there was not time to burn the branches, and they were left to rot on the ground. I never detected the slightest appearance of beetles in this plantation previous to the thinning, nor after it till this spring, when I found many of the side branches had been attacked by the large beetle—*Hylobius abietis*. If the beetles had been on the trees previous to this thinning, those that were lifted would likely have had them too, but upon those there was not a beetle nor the trace of a beetle to be found. Therefore I advise all Scotch fir rubbish to be gathered and burned up as a great means of getting rid of beetles.

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X. *On the Best Modes of Starting from Seed, or Rearing from Cuttings or Grafts the various newer Coniferæ.* By JOHN ALEXANDER, Assistant Forester, Abernethy, Strathspey.

Every plant can be reared from its seed, and, theoretically, this ought to be the best and surest mode of propagation. But as this cannot always be done, other modes of propagation have been resorted to, such as by cuttings and grafts. We at present treat only of the coniferæ or cone-bearing trees and shrubs, and shall refer to them—*First*, of those reared from seeds; *secondly*, from grafts; and, *thirdly*, from cuttings.

1. *Coniferæ from Seeds.*

The cones should be gathered in the winter season, and afterwards exposed to the sun, or to a gentle heat on a kiln, to facilitate the separation of the seed from the cones. In the Scotch fir, and others of like nature, the cones open in a very short time after they are treated as above.

Those of the Weymouth pine, silver fir, and balm of Gilead fir, give out their seed with still less trouble; while, on the other hand, the cones of the *Pinus Pinaster* (cluster pine), *Pinus Pinea* (stone pine), and allied species, do not open their scales for several months, although treated in the same manner. The cones generally opened by kiln heat are those of the Scotch pine, spruce, and larch. But there are others, as those of the cedar of Lebanon, which should be left for a year at least before the seeds are taken out; this being necessary on account of the soft nature of the seeds and the great quantity of resin which the cones contain while growing, and which they discharge on being kept for some time after they are gathered.

A fact which the writer has verified during the last two years may be mentioned as a guide to cone-gatherers. In the year 1870, twenty cones were gathered from each of ten different trees, whose ages were approximately ascertained by counting the concentric circles in other trees felled beside them. The cones were carefully opened, and all the seeds of the ten different sets sown in separate beds, when the following was the result:—

The seeds of 20 cones from a tree

300	years	old	produced	10 plants.
250	,,	,,	13	,,
200	,,	,,	50	,,

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150	years old	produced	74	plants.
125	,,	,,	106	,,
100	,,	,,	196	,,
50	,,	,,	104	,,
15	,,	,,	46	,,
10	,,	,,	40	,,

The same experiment was tried in 1871 with other trees, when the result was much as in 1870. It would thus appear that the best trees to take cones off for seed are those averaging about 100 years. Above 100 or 120 years the seed becomes less fruitful; at any rate, the fact remains that the cones of trees, when they reach their prime, are more fruitful than those of old ones. April is the best season for sowing all kinds of conifers, should the weather prove favourable, in order that the seeds may sprout the earlier. It is a good plan to place them in a bag, and then have the bag steeped in water for two or three days. After this let the seeds be taken out and dried gently in the sun before being sown. The soil should be soft and rich, mellowed by the preceding winter's frost, and carefully dried, and raked as fine as possible. The rarer sorts are generally sown in pots, but the more common in beds 3½ feet wide. The seeds of the Scotch pine require a covering ½ inch in depth; those of the Weymouth pine ¾ inch; and those of the stone pine, 1¼ inch. The cedars are generally sown in broad pots or boxes filled with light sandy loam and covered ½ inch. In the case of the larch the seeds require ¼ inch, while, again, those of the spruce fir require about an inch. Those of the silver fir and balm of Gilead from ½ to ¾ inch. The seeds of the black and white American spruces are smaller than those of any of the preceding species, and therefore require a light covering. It is sufficient to cover these seeds and no more. Strict attention is required, both as to the quality of the soil and the thickness of the covering; for although the plants from these seeds prove extremely hardy when grown up, yet they are very tender in infancy. It is a common practice to leave the plants in these beds for two years, but this is not to be recommended. They should, if possible, be lifted in the end of the first year in March or April, according to the weather, and then bedded out in lines six inches apart with 30 or 40 plants to the lineal foot. At the end of the second year they should be again lifted, and this time lined in rows 9 inches apart, and about 18 or 20 plants to the lineal yard. In the course of the third year these plants are fit for being trans-

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planted into a forest or pleasure ground, as the case may be; they will then be from 6 to 9 inches high, and if larger plants are wanted they may either be left in the lines or transplanted to others.

2. *Coniferæ from Grafts.*

Trees not too full of resin can be propagated by cuttings and grafts, and often make good plants. The process of grafting is well known to every nurseryman, and need not be here explained. But it may be remarked that the graft commonly known as "tongue upon tongue" is superior to the other modes, such as "*side*" grafting, "*cleft*" grafting, and "*crown*" grafting. The great art consists in fitting exactly the inner bark of the scion to the inner bark of the stock, and keeping them in close contact till union takes place; and the "*tongue*" or "*whip*" grafting, as it is sometimes called, answers this purpose best in case of Coniferæ, for among other reasons it admits of being performed even on the smallest twigs. The grafts will not succeed unless the scion and stock be of the same species, or, at least, of the same genus. The scions are generally young twigs of last summer's growth or young branches, and are grafted on to the stocks in the case of Coniferæ, immediately after they are cut from the parent stem. This should be done when the sap begins to ascend freely through the inner bark of that which is to form the stock. The proper season is easily known from a tree putting forth its buds.

Of the Coniferæ from grafts or cuttings all the Picea and Pinus are best from grafts when seeds cannot be got. The Piceas will graft and grow well on the silver fir (*Picea pectinata*). The Pinus genus takes on different varieties of stocks. For example, those that bear a resemblance to the Scotch fir (*Pinus sylvestris*) grow very well on that species as a stock. Varieties such as *Pinus monticola*, *P. Lambertiana*, &c., make the finest trees on *P. excelsa* or *P. Strobus* (Weymouth pine). All the varieties of Abies are grafted on the common spruce, and all the Bitas and *Thuja orientalis* varieties on the Chinese Arborvitæ, and Cephalotaxus on the common yew. The *Cupressus Lawsoniana*, which is easily reared from seed, can be used as a stock for all its varieties and those of allied species.

3. *Propagation by Cuttings.*

These should be taken from the side shoots of plants when the sap is in full motion, as in the case of grafts. They should consist of last year's growth with a small part of the previous year's wood.

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The old wood causes them to strike better. The cuttings from Coniferæ will grow in almost any soil, but a loamy and cool subsoil is best for bringing the trees to perfection. The varieties of *Retinospora* make fine plants from cuttings, as also, those of yews and *Thujopsis*. Wellingtonias are reared better from cuttings than grafts, but the variegated forms are commonly grafted on the original species. *Cedrus*, *Cephalotaxus*, *Cryptomeria*, *Dacrydium*, *Podocarpus*, *Prumnopitys elegans*, and *Pseudo Larix*, with many of the cypresses, can be propagated by cuttings. Of Conifers, not already mentioned, the following may be propagated, either by cuttings or grafts—most kinds of junipers, the *Libocedrus chilensis*, *L. decurrens*, *Torreya grandis*, *T. taxifolia*, and the white cedar.

We have now seen how the different varieties of Conifers are propagated from seeds, grafts, and cuttings; and it may be repeated that the first is the best mode of propagation where practicable, and of the other two, rearing from cuttings is generally to be preferred to that from grafts, for the latter often send out lateral instead of upright leaders.

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XI. *On the Distribution of Forests in India.* By DIETRICH BRANDIS, Ph.D., Inspector-General of Forests, Calcutta. (With a Map.)

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In all countries the character of forest vegetation mainly depends on soil, climate, and the action of man. In India the greater or less degree of moisture is perhaps the most important element in this respect. Moisture and rainfall are not identical terms. Dew and the aqueous vapour, dissolved in the atmosphere, or the water derived from the overflow of rivers and from percolation, are sources of moisture as important for the maintenance of arborescent vegetation as the fall of rain and snow. It would greatly facilitate the labours of the forester, and of the botanist who inquires after the geographical distribution of forest trees, if the amount of atmospheric moisture and the formation of dew during the seasons of the year in different parts of India had been sufficiently studied; but, in the present state of our knowledge, we must be satisfied with dividing India into regions and zones according to the more or less heavy rainfall during the year. The arid region, with a normal annual rainfall of less than fifteen inches, occupies a large proportion of the north-west corner of India, from the Salt range in the north, to the mouths of the Indus in the south, and from the Suleiman range in the west to the Aravulli Hills in the east. It includes the southern portion of the Punjab, the province of Sindh, the States of Bhawulpoor, Kairpoor, Bikanir, Jessulmir, and the greater part of Marwar. Throughout this vast region, which covers an area equal to that of the kingdom of Prussia, with a population of about twelve millions, the rains are not only scanty but most uncertain. It is not a rare occurrence for several years to pass in succession without any showers, and then there is a heavy downpour, generally in winter, and occasionally in August or September. There are, however, no regular winter or summer rains. A scanty, thorny scrub on the hills gives ample employment to the botanist, for it is here that the representatives of the Arabian and Persian flora mingle with the vegetation which is peculiar to India; but the work of the forester is mainly confined to the belts of low country along the Indus and its great branches. In Sindh, for instance, the area of forest land at the disposal of the State covers 350,000 acres, all situated on the fertile alluvial soil on both banks of the Indus, some of which is inundated annually by the summer floods of this large river, the remainder being moistened by percolation. In lower and middle

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Sindh a large portion of these forests consists of the babool (*Acacia arabica*), more or less pure, with a shade so dense that very little grass or herb grows under the trees. In northern Sindh extensive shrub forests of tamarisk, with standards of acacia and a poplar (*Populus Euphratica*), cover large tracts along the banks on both sides of the river. As the Indus changes its course from time to time, leaving dry last year's bed, and breaking through at another place, forming a new channel, the fresh banks and islands which are thus thrown up are covered at once by a dense growth of self-sown seedlings of tamarisk, with a sprinkling here and there of the acacia and poplar; while in other places large tracts of old forests are carried away by the encroachments of the river. Outside these forests, a little further inland, but still to a certain extent under the moistening influence of the river, are vast tracts of kundi or jhund, an acacia-like tree (*Prosopis spicigera*), *Salvadora*, and an arborescent, leafless Caper (*Capparis aphylla*); and further north, in the Punjab, where the rainfall is more regular, and its annual amount approaches or exceeds ten inches, dry and scanty woods, mainly composed of *Prosopis*, *Capparis*, and *Salvadora*, cover a vast extent of country on the high ground between the rivers of that province. These woodlands are commonly known under the name of rukhs, and they extend far into the second zone, which may be termed the dry region of India, and in which the normal rainfall is between fifteen and thirty inches.

There are two zones of dry country,—one surrounding the arid region on the north and east, in a belt from 100 to 200 miles wide, leaving the foot of the Himalayan range about Umballa, touching the Ganges at Futtehgurh, and including Delhi, Agra, Jhansi, Ajmere, and Deesa. This I propose calling the northern dry zone; its natural forest vegetation is scanty, but better than that of the arid region. In some of the states of Rajpootana there are extensive woodlands carefully preserved, to furnish cover for game, a regular supply of wood and grass, and in times of drought, pasture for the cattle of the vicinity. In the north these woods consist of *Acacia* and *Prosopis;* further south, mainly of a species of *Anogeissus*, a beautiful tree, with small leaves, drooping branches, and dense foliage, which clothes the slopes of the old fort of Chittore and other hills in Meywar, and is the principal tree of the sacred groves of that country. On the Aravulli hills in Meywar, where cultivation mainly depends on the water stored up in tanks, the value of preserving the scanty thorny scrub on the hills, in order to regulate the filling of the tanks from

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rain, is recognised by some of the larger landholders. Nor must we forget that we owe the maintenance of the forests in Sindh and of the rukhs in the Punjab entirely to the action taken by the former rulers; and that during the first period after the occupation of the country, the action of the British Government has not in all cases been favourable to the preservation of the forests and woodlands in the arid and dry regions of India. Great exertions have, however, been made of late years to make up in some measure for past neglect in this respect, and in the Punjab extensive plantations have been established since 1865, which now cover upwards of 12,000 acres, the main object in the formation of these new forests being to provide fuel for the consumption of the railways, and fuel and timber for the large towns in that province. The first commencement of these plantations was made by Dr J. L. Stewart, the author of several valuable books and papers on the vegetation of North-Western India. There is a second dry region in the Peninsula, comprising part of the Deccan, the Maidan or open country of Mysore, and several districts of the Madras Presidency. Exceptionally moist places are within its limits, such as Bangalore, which, being situated 3000 feet above the sea, has thirty-five inches rain; but upon the whole, and excluding such hills as rise considerably above the table-land of South India, this belt, which stretches from Nassick in the north to Cape Comorin in the south, has a normal rainfall of less than thirty inches. This belt includes Poona, Bellary, and Kurnool in the north, and Madura and Tinnevelly in the south. Over a great part of it is found the sandal-wood (*Santalum album*), a small tree with fragrant heart-wood, which comes up here and there in bushes and hedges, but does not grow gregariously, and does not form pure forests. Large quantities of this delightfully fragrant wood are used for carving and inlaid work, as incense in Hindoo temples, and there is a considerable export of it to China.

Outside these two dry zones the normal annual rainfall exceeds thirty inches, save north of the first great snowy range of the Himalaya, where rain and snow are scanty, and the country consequently arid and bare. The rest of India has a rainfall greater than that of Europe. Yet really thriving forests are only found where the fall exceeds forty inches, and rich luxuriant vegetation is limited to those belts which have a much higher rainfall. It must be borne in mind that the annual mean temperature of Central Europe ranges between 45° and 60°, while that of India is as high as 75° to 85°. Under a higher temperature a larger amount of moisture is required to pro-

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duce rich vegetation. At the same time, in India, the supply of moisture is unequally distributed over the seasons of the year. In most districts the year divides itself into two unequal parts,—a long dry season, and a short rainy reason. In most provinces of India the principal rains are summer rains, due to the prevalence during that season of the south-west monsoon, and the most humid regions are those tracts which are fully exposed to the influence of these moist south-westerly winds. In addition to these, there are Christmas or winter rains in Northern India, but they only last a few days, or at the outside a week a two, and are, moreover, extremely uncertain and irregular. On the eastern coast of the Peninsula the summer rains are slight, the principal fall coming with north-easterly winds in October and November. But in the greater part of India the dry season lasts from November to May, the rains commencing between May and July, and ending between August and October. In the moister districts the rains commence early and last longer, while in the dry belts there is rain only during two or three months of the year; and in the arid region the rainfall is altogether uncertain.

The temperature during this long dry season is cooler at first and warmer afterwards. The mean temperature of the three months, December, January, and February, generally termed the cool season, ranges between 60° in the Punjab, and 79° in the south of the Peninsula. During these months dew is formed more or less regularly, and contributes much to the maintenance of vegetation, particularly in the dry and arid zones. Radiation is so powerful during this season that frost is not of uncommon occurrence in the plains and lower hills of northern and a part of Central India. These night frosts have interfered much with the satisfactory progress of the plantations in the Punjab, and as far south as Sukkur on the Indus, in latitude 27° 30′, and the Satpoora range in the Central Provinces, in latitude 23°, frost is a serious difficulty in arboriculture. As far south as Calcutta, ice can be made on carefully prepared beds covered with straw, shortly before sunrise on a still, clear morning. The mean temperature of the three months which follow, which are generally called the hot season, is 75° in the Punjab, 85° along the coast line, and 90° in the interior of the Peninsula, and this dry heat, with the hot scorching winds which blow over a great part of India during these months, makes this season extremely trying to forest vegetation.

With the exception of the extensive evergreen forests of the Himalaya, and the limited tracts of evergreen forests in the plains and lower hills of the humid regions, the great mass of forests in

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India are deciduous, and they are bare and leafless during the hot season. During this time of the year, the sojourn in the Indian forests is not pleasant. No shade, no protection against the fierce rays of the sun, great scarcity of water in many parts, and a tent or hut with a temperature in its coolest part of 105°,—these are conditions of existence which are not easily forgotten. Deciduous, however, as applied to trees is a relative term. The only difference is, that an evergreen tree retains its leaves longer than one which is called deciduous. Thus the spruce and silver-fir retain their needles from seven to eleven years, the Spanish *Pinus Pinsapo* and the *Araucaria* retain them even longer, hence the full foliage and the dense shade of these trees. On the other hand, the needles of the Corsican and Austrian fir (*Pinus Laricio*) remain three to four years; and the Scotch fir, with lighter foliage, has needles of two or three years only on its branches. The Sal tree (*Shorea robusta*), one of the most important timber trees of India, with strong, hard, heavy wood, which forms extensive forests along the foot of the Himalaya and in the eastern part of Central India, retains its leaves nearly twelve months; the old leaves fall gradually, and the foliage gets thinner and thinner, until the new flush of leaves breaks out in March or early in April. So that although a sal forest is hot during that time of the year, and there is not much shade, yet the tree is never completely bare. The Teak tree, on the other hand, which may be called the king of Indian timber trees, on account of its useful, durable, strong, and yet not very heavy wood, sheds its leaves as early as January, and is leafless for four or five months, though this again depends upon the supply of moisture, for in low humid places the tree often continues green throughout February. Fortunately for foresters in the hot dry provinces of India, there are to be found in most dry deciduous forests one or two kinds which break out in leaf sooner than the others, and I have spent many an hour during the heat of the day under the grateful shade of what we call the forester's friend (*Schleichera trijuga*), a tree remarkable for its extremely heavy wood, the cubic foot weighing, when perfectly dry, over 70 lbs., or nearly three times the weight of common deal.

The grass and fallen leaves, in these dry, deciduous forests, dry up rapidly during this season, and towards March and April everything is so scorched that it is as inflammable as tinder, so that the smallest spark is sufficient to create a conflagration. These jungle-fires are almost a regular annual institution in the deciduous forests of most provinces. In some instances, they are caused by accident,

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but in the majority of cases they arise from the temporary clearings made by cutting and burning, and the custom of the herdsmen to burn down the old grass in order to cause the fresh tender shoots to spring up as fodder for their cattle. It is true that these fires clear the ground, and make walking through the forest easier; and, up to the present time, many otherwise observant people in India have been of opinion that these fires are not mischievous, and might in some cases be beneficial. The damage, however, done by them defies calculation. Millions of seeds and seedlings are destroyed, trees of all ages are injured, and often killed, the bark is scorched and burnt, the wood exposed to the air, dry rot sets in, and the tree gets hollow and useless for timber. One of the most remarkable facts in the working of the Indian forests in the plains and lower hills has been the large proportion of hollow and unsound trees. In many forests one-half, in others three-fourths of the mature trees are hollow. To a certain extent this is due to the old age of the timber felled; but experience elsewhere proves that old age can only account for a small proportion of the hollow and unsound trees. The annual jungle-fires are the principal cause of this mischief. In this respect all deciduous forests in India suffer alike. With regard to reproduction, that is, the growth of seedlings, some trees are better off in this respect than others. Thus the Sal trees ripens its seed about the commencement of the rains, after the jungle-fires have passed through the forest. The young plants thus germinate at once in great abundance. The jungle-fires of the coming season kill a good many, and cause a large proportion of the others to grow hollow; but in the dense mass of seedlings which clothes the ground under the parent trees in a sal forest, the damage done is comparatively small. This, to a certain extent, explains how the sal forests are nearly pure, the stronger tree in the matter of reproduction predominating over all the rest. The Teak, on the other hand, ripens its seed early in the dry season, the jungle-fires consume large quantities of it; a smaller proportion of seedlings spring up, and these are either killed or cut down to the root year after year by the fires. Meanwhile, the root-stock increases in size every year by the action of the shoots, which come up during the rains, and at last, often after the lapse of many years, it produces a shoot strong enough to outlive the fires. Thus what appears a seedling plant of teak is in most cases really a coppice shoot from a thick gnarled root-stock, bearing the scars of successive generations of shoots, which were burned down by the annual fires.

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Protection against fires is not an easy task in our European forests. Many square miles of Scotch fir in Eastern Prussia, where this widely spread tree is the prevailing kind, have at various times been burned down, and in the cork oak and *Pinus maritima* forests of Provence the ravages have been terrible, the long summer drought of Eastern Europe and of Southern France having in this respect the same effect as the long dry season in India. But in India the task has been a particularly difficult one. The first step was to convince people that these fires were injurious, and when that was accomplished, to isolate the tracts to be protected by clearing broad firepaths round them, and burning down, early in the dry season, all grass and leaves in a broad belt surrounding the forest. The credit of having been the first to take in hand this important work on a large scale is due to Colonel Pearson, in those days in charge of the forests in the Central Provinces, and now holding a most important position in the Forest Department under the Government of India. It is mainly due to his energy and perseverance that fires have been kept out for more than six years from a large forest tract of thirty square miles, called the Bori Forest, producing teak, bamboos, and various useful trees, in the Satpoora range. The effect has been marvellous, and if these exertions are steadily continued, this forest promises to become one of the most valuable in the central parts of India.

From what has been said, it will be understood, that in the plains and lower hills of India the annual repose of arborescent vegetation is not caused by the cold of winter, but mainly by the drought of the hot season. Shortly before the rains set in, or with the early showers which precede the monsoon, most trees clothe themselves with fresh green, and in the arid region, where the periodical summer rains are wanting, the summer floods of the river revive the forest growth on its banks after the long drought of the dry season. In those parts of India which have a heavy monsoon, the temperature is generally somewhat lower during the summer months, June, July, and August, than during the preceding hot season. Thus it is that on the western coast of the Peninsula the mean temperature of the hot season is 85°, and that of the three succeeding months, when the sky is overcast with clouds, and the force of the sun's rays is rarely felt, is only between 80° and 82°. On the Burma coast also, in Akyab, Rangoon, and Moulmein, the mean temperature of the monsoon months is somewhat lower than that of the preceding hot season. The relief from the incessant powerful action of the sun's rays,

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brought about by the storms of the monsoon, and the cloudy and rainy weather which follows, is delightful. It is not the vegetation only which revives; the whole animated nature feels the pleasant change. This relief is denied to the arid region. Here, in the north-west corner of India, the temperature continues to rise higher and higher with the sun, and the result is, that in June, July, and August, the highest mean temperature is found in the arid zone of India. Thus Multan has a mean temperature of 77° during what is termed the hot season in other parts of India, and of 92° during June, July, and August; and at Jacobabad, in Sindh, the mean temperature during these months is as high as 96°. Where, however, sufficient water is supplied by irrigation, these high temperatures stimulate vegetation in a remarkable manner. The station of Jacobabad is a striking example of the effect of water supply in that climate. It was founded in 1844 by General Jacob, in the midst of a barren, treeless desert. A canal was led to it from the Indus, and now the plain is a dense forest of babool and other trees, upwards of sixty feet high, sheltering the houses and gardens of the inhabitants. A ride of a few miles takes you into the desert which skirts the hills of Beloochistan, a level plain of splendid, fertile, alluvial soil, but hard, naked, and barren, like a threshing floor, without shrub, herb, or grass, except in the vicinity of the canals, where vegetation is rich and luxuriant.

In the Himalayan hills, vegetation rests in winter as it does in Europe, and in the vast tracts of those mountain ranges the forester finds himself surrounded by forms similar to, and in a few cases identical with, the trees and shrubs of Europe. The climatic conditions are analogous, though not identical. At the higher elevations the year divides itself into the four seasons with which we are familiar in Europe, but the main supply of moisture is in summer, and the summer rains are preceded by a long dry season, which is much warmer than the spring is in Central Europe. In the outer ranges, the rains are heavy, but the whole falls in torrents within a few months, and has not, therefore, the same effect upon vegetation as the uniformly distributed moisture of our own climate. There are other points of difference in the climate of the higher Himalayan ranges and of Central Europe, and this explains that some of the hardiest Himalayan trees, which grow at an elevation of 12,000 feet, within a few thousand feet of the line of perpetual snow, such as the silver fir (*Pinus Webbiana*), refuse to thrive in Great Britain and on the Continent. Even the Deodar (*Cedrus deodara*) and the blue

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Himalayan pine (*Pinus excelsa*), which are common in parks and gardens in England, do not thrive in many parts of Europe.

There is a great difference in the total rainfall in the outer and inner belts of the Himalayan forests. At Simla, and in the vicinity, on the outer ranges, the fall is from seventy to eighty inches, and here the Deodar attains a diameter of two feet in from sixty to eighty years. The moist southerly currents which prevail in summer pass over the hot plains of the arid region without depositing their moisture; but as soon as they are brought into contact with the cooler air of the hills and forced upwards into regions of less atmospheric pressure, condensation begins, and their surplus moisture is deposited in the shape of torrents of rain. Thus, there is on the outer ranges of the north-west Himalaya a narrow belt, not more than thirty miles wide, with a rainfall exceeding seventy-five inches. Further inland the fall decreases rapidly—Kotgurh, for instance, distant forty miles from Simla, has thirty-eight inches only. Beyond the first snowy range the rains are scanty. Here, at the same elevation as in the vicinity of Simla, the Deodar takes from 150 to 200 years to obtain a diameter of two feet; higher up the valley, at a distance, as the crow flies, from the plains of 120 miles, spontaneous arborescent vegetation ceases entirely, the last being the tree juniper (*Juniperus excelsa*), fine specimens of which may be seen growing in Kew Gardens.

The moist zone, with a normal annual rainfall, exceeding seventy-five inches, which comprises the outer Himalaya, extends north-west as far as the Dhaoladhar range, which borders the fertile district of Kangra. Beyond this the fall even on the outer hills is less. Thus the station of Abbotabad, between the rivers Jhelum and Indus, has only forty-one inches. South-eastward the moist zone widens. In Lower Bengal the line which indicates its limit passes through Dacca, reaching the coast west of Chittagong, so that Assam, the Khasia hills, Silhet and Cachar, Tipperah, and Eastern Bengal, are all included. This, the north-eastern moist region of India, also comprises Arracan and the coast districts of British Burma. The eastern portion of this extensive moist belt has a much heavier rainfall than the north-western portion, and here again it is heaviest on the mountains. Thus, Darjiling, in British Sikkim, at an elevation of about 7000 feet, has 125 inches; and Cherra, the former Sanatarium on the Khasia hills, at 4000 feet, has an annual fall of 600 inches, or fifty feet. On the Burma coast also the rain is heavy. Thus Akyab, the chief town of Arracan, has 219; Tavoy, further south, on the

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Tenasserim coast, has 201 inches; and Rangoon, situated at some distance from the sea in a wide extent of nearly level country, has eighty-five inches.

On the higher mountain ranges of this extensive moist region, forests of pines and other conifers extend from the north-west Himalaya southwards to the mountains of Burma. The Deodar has its eastern limit in Kumaon, but there are other coniferous trees, which extend over the eastern part of the Himalaya range. One of the finest of these is *Pinus Khasiana*, which is found as far south as the high mountains between the Salween and Sitang rivers in British Burma. These mountains are the seat of a numerous Karen population, formerly an idle, drunken, and lawless race, which, through the teaching of Christianity, brought to them by American missionaries, have become an industrious, sober, and peaceful people. Some of their villages are in the midst of these splendid pine forests, and I have often, when coming from the teak forests in the hot valleys of the Salween and Sitang, been refreshed by the delightful fragrance and cool shade of the pine trees on these hills. But, as if to remind the botanist that, though in a pleasant, cool mountain climate, he is within the tropics, and only 19° distant from the equator, there is an underwood of the sago palm (*Cycas*) under the pine trees, and most of the Karen villages are surrounded by the gigantic bamboo, which yields the posts, rafters, walls, and floors of their houses. The joints of this bamboo are so large that they are used as water pails and buckets. There is another pine tree in Burma, nearly related to a Japanese species, which grows at a lower elevation in the midst of the dry and hot tropical deciduous forests.

These tropical and subtropical pines, however, are not yet of much practical importance. The production of teak timber is the main object which the forester has in view in those parts of the country. The export of teak timber from Rangoon is of old date; but, under the Burmese rule, the quantity exported never came to any very large amount. When the province of Tenasserim became British in 1826, the Attaran forests, which are situated south of the town of Moulmein, were worked with great energy, and yielded large quantities of excellent timber. The supply from that source, however, soon diminished, and thus the attention of timber traders was directed to the extensive teak-producing forests beyond the British frontier, on the Salween river and its tributaries, and from that time the importation of foreign timber into Moulmein has steadily increased until within the last few years, when the quantity floated down decreased,

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mainly because the stock of good timber in the vicinity of the river and its tributaries had gradually become less. Soon after the annexation of Pegu, in 1853, the forests of that province were placed under a regular system of administration, and in 1858 this system was extended to the forests in the province of Martaban and Tenasserim. The result has been, that, without impairing their productiveness, the out-turn of the forests in British territory has gradually been raised from an insignificant figure to a very considerable amount; so that within the last five years they have yielded between one-third and one-half of the total quantity of teak timber brought to the principal sea-ports. The timber trade of the Burma ports is not large as compared with that of Canada, yet it is of considerable importance, the export amounting to about 100,000 tons annually, with a value of about L.700,000. The forests in the king of Burma's territory, in Siam and the Karenee country, are much more extensive and rich in fine timber than those in our own territory; yet, unless placed under a regular system of management, they will surely be exhausted before long, and on that account we must, to a great extent, look to the forests within British territory for the maintenance of the supply in future. It is satisfactory that the efforts to protect and improve the forests in British Burma have also financially been remunerative. Within the last four years the gross revenue from these forests has fluctuated between L.64,700 and L.98,400, and the net annual surplus to the State has been between L.31,900 and L.56,500.

The teak tree in Burma, as elsewhere, is found in the dry deciduous woods, never forming pure forests, but always growing in company with a large number of bamboos and other trees. Its growth is rapid while young, but slow at a more advanced age. In 1862 I sent a few teak poles, thirty feet long, to the great London Exhibition; they had attained that size in two years, in a moist part of the country, on rich soil, and protected from fire. On the other hand, the results of researches made regarding the age of mature trees have led us to the conclusion that more than 100 years are required on an average for the teak tree to attain a diameter of two feet. The fires clear the ground annually of dry leaves and grass, which would otherwise form vegetable mould, enrich the soil, and keep it moist and loose. The bare ground, exposed to the full force of the sun, dries up rapidly with a hard baked surface, the rains of the monsoon rush down the hills and slopes, and the ashes, the remains of the fires, are washed away, without contributing much to the nourishment of the trees. Thus the fires do not only injure the regenera-

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tion of the forest, cause the timber to grow up hollow and unsound, but they also impair the productiveness of the soil, and retard the rate of growth of the trees. In Burma the fires are principally caused by the practice of toungya cultivation. The forest, instead of being converted into permanent fields, is cut down in January; and in March or April, when the large mass of stems, branches, and bamboos, which cover the ground, have become sufficiently dry, it is burned. On the first rainfall, rice, cotton, and vegetables are sown, and yield an abundant harvest, no ploughing and digging, only weeding and reaping being necessary. In some cases a second crop is taken; but after that, and more often after the first crop, the field is abandoned, a fresh piece of forest is selected for burning, and in this manner destruction spreads rapidly over large areas. Some of the finest teak forests in British Burma have been destroyed by these clearings; and, with the steady increase of population under British rule, the injury done by this erratic kind of husbandry has become enormous. This mode of wandering cultivation is practised throughout the wilder parts of India; in Mysore, where it is known under the name of kumri, it was possible, about twenty years ago, to protect the forests by stopping this practice throughout the country. This result was mainly due to the exertions of Dr Cleghorn, for many years Conservator of Forests in the Madras Presidency, and afterwards employed by the Government of India in the organisation of forest administration in the provinces of Northern India. In Burma, such a summary course of procedure was not found practicable, and instead of protecting the whole of the forests, all that could be done was to prohibit toungya clearings in a limited extent of the best teak-producing tracts, and in those localities which were set apart for the formation of new teak forests by planting. The selection and demarcation of these tracts, which will eventually be the State forests in that province, has not progressed rapidly, and these reserved forests in Burma do not yet amount to more than about 80,000 acres, 1600 acres of which have been covered with teak plantations.

Besides the dry, deciduous teak-producing tracts, there are in the moister parts of the lower hills of Burma extensive and most luxuriant evergreen forests, composed of a large variety of trees, often 200 feet high and more, and so dense that except on the numerous paths trodden by wild elephants, or on the scanty footpaths which lead from village to village, it is almost impossible to penetrate through them. The forester classifies trees with special

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reference to the amount of light which they require. The Scotch fir, for instance, demands a great deal of light; its seedlings will not readily spring up and thrive under the shade of its own kind or of other trees. The beech, spruce, and silver fir, on the other hand, can stand a great deal of shade; their seedlings will maintain themselves a long time in the deep shade of the forest, growing very slowly, making very little progress; but when a clearing is made accidentally or intentionally, they will shoot up with great vigour. Where woodlands are managed on a large scale, the peculiarities of each kind of tree are carefully studied, and the treatment of the different classes of forest is adapted to them. In India, teak demands a great deal of light. On the other hand, most of the trees which compose the tropical evergreen forest will stand a great amount of shade; and thus it happens that the underwood of these dense forests does not only consist of shrubs and climbers, but to a great extent of seedlings of the very trees which form the dense shady roof overhead. When one of these old giants falls, the mass of seedlings takes a start, and as they all strive upward to the light they draw each other up to a great height, the weaker plants perishing in the fierce struggle for existence. The trees in these forests cannot, however, either in height or growth, be compared to the Wellingtonia of California or to the Eucalyptus of Australia. The tallest tree which I have seen and measured in India was 250 feet high and 38 feet in girth. This was a species of upas tree (*Antiaris*), in the Thoungyeen forests of British Burma. Such dimensions, however, are never found in the deciduous forests. The tallest teak tree measured by me was 102 feet to the first branch, with, perhaps, an additional 50 feet of crown above. Teak trees with clear stems, 60 to 80 feet to the first branch, are not rare in the moist regions of India. I have found them in Burma, in the Dang forests, north of Bombay, and in those glorious but hot forests of North Canara, which are probably the most extensive and richest teak forests remaining in British India. Teak of such size and length is only found in very favourable localities, where the young trees had grown up close together on rich dry soil, in dells or sheltered valleys, generally in company with tall bamboos, and where they were thus compelled to draw each other up to that height.

Luxuriant vegetation, under the influence of an abundant supply of moisture, has its drawbacks, however, as well as its advantages. Thick masses of tall grass and weeds spring up in the teak plantations of Burma, smother the young trees, and greatly increase the

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risk of fire. Worst of all are the climbing plants with which the teak, sal, and other forests in all moist tracts abound. Huge creepers, like gigantic ropes, often as thick as a man's thigh, and thicker, stretch from the ground to the top of the trees: they give off numberless branches, and their foliage completely covers and smothers the crown of the tree of which they have taken possession. When a young tree is attacked by one of these gigantic climbers, the stem remains short, gets crooked and deformed, and makes no progress in growth. In Burma several kinds of epiphytic Ficus attack teak and other trees; the seed germinates in a fork or in a hollow of the trunk, sends down its roots, which eventually enclose the stem as with a network. At last the tree dies, and the Ficus spreads its massive but useless limbs in all directions. In the sal forests of Oudh the creepers were particularly heavy and numerous when these tracts came into our hands. Owing to several favourable circumstances, it was possible in that province at once to set apart and demarcate a large area of forest land as State forests, and the work of cutting the creepers was at once taken in hand and completed at a considerable outlay; so that now these forests are almost entirely cleared of large climbers, and the young sal has a chance of growing up straight, and forming valuable timber.

Much smaller in area than the north-eastern moist region is that which extends along the western coast of the Peninsula. It begins north of Bombay, and, guided rather by the character of the vegetation than by meteorological observations, which in those wild tracts we do not possess, I have included in it the northern Dangs, a dense and most feverish forest district at the foot of the Khandeish ghats. The eastern limit of this western moist zone runs nearly parallel with the crest of the ghats, but at a short distance from the ghat line. The moist zone thus includes the edge of the ghats, their western slope, and the hilly country between the ghats and the coast line. Its width varies from 50 to 100 miles. Surat, with 47 inches of rain, is outside; Bombay, which is included, has a fall of 72 inches only, but Tanna, a few miles inland, has 102. Further down the coast, the rainfall is heavier. Rutnagerri has 115 inches, Vingorla 118, and Cananore 123. But the heaviest fall in this zone is on the crest of the ghats. Here, as on the outer ranges of the Himalaya, and the Khasia hills, the moist currents of air coming from the west, which strike against the steep face of the ghats, are forced upwards into a cooler and more rarified air, and the consequence is an extremely heavy downpour during the monsoon. Thus the Sana-

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tarium of Mahableshwur, south of Bombay, 4300 feet above the sea, has a fall of 250 inches; but Panchgunny, at a distance of only 10 miles inland from the crest of the ghats, has 50 inches; and Poona, 30 miles from the ghat line, has a fall of only 27 inches. This rapid decrease of moisture inland explains that the western limit of the southern dry belt runs within a short distance from the crest of the ghats. At the southern extremity of the Peninsula the rain near the coast diminishes, so that Cape Comorin, with 28 inches, and Palamcotta, with 22, fall into the southern dry zone.

Forest vegetation in the western moist region is in places fully as luxuriant as in Burma and Eastern Bengal. There are the same great classes of dry deciduous forest, with the jungle-fires as a regular, annnally recurring institution, and the moist evergreen forests, including what are commonly called the Sholas of the Neilgherries, into which the jungle fires do not enter. The rich variety of trees in both descriptions of forest has been carefully studied by Major Beddome, the present head of the Forest Department in the Madras Presidency, and author of the first forest flora published in India, containing a full account of the trees and shrubs of Southern India. In the forcing climate of Malabar, in the heart of this moist region, is the oldest and as yet most extensive teak plantation in India. Commenced in 1844 by Mr Conolly, then Collector of that district, its present extent is upwards of 2500 acres. A hundred acres on an average were planted annually, so that there is a regular succession of thriving plantations, the oldest being now twenty-eight years old, with tall stems 70 to 80 feet high, a splendid instance of the rapid growth of the teak tree in its youth, under good care and in a favourable climate. The northern half of the western moist zone is in the Presidency of Bombay. In this part of India a regular administration of the public forest-lands was attempted as early as 1846, and the result of the early attention paid to this matter may be seen in a large and steady forest revenue, between L.82,000 and L.123,000 annually during the last six years, one-half of which has been a net addition to the general revenues of the Empire. At the same time, the forests in several districts of the Presidency have considerably increased in value; they now contain a larger stock of growing timber than at the time that conservancy was commenced, and plantations have not been neglected.

While thus a good deal has been done to increase the growth of useful indigenous trees, the introduction of foreign trees has not

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been neglected in India. The splendid table-land of the Neilgherries, which is raised 7000 feet above the hot plains, is in places getting rapidly covered with forests of exotic trees. From Australia several kinds of *Eucalyptus* and *Acacia* were introduced about twenty-five years ago, and they have made such progress that the station of Ootacamund is now almost surrounded by a forest of these trees. Their rate of growth is wonderfully fast, much faster than that of the indigenous trees. At the same time, young forests of the quinine-yielding *Cinchonas* are coming up in many places. The management of these Cinchona woods will probably be similar to the treatment of oak coppice in England; for though oak bark has not one-twentieth the value of Jesuit's bark, it is the bark in both cases for which these woods are mainly cultivated. There will, however, be that difference, that while oak coppice in Europe, after having been cut over, requires from fourteen to twenty years to yield another crop of bark, Cinchonas appear to grow so rapidly that they may probably be cut over every eighth or tenth year. Fever is the great scourge and calamity of India, for natives as well as for Europeans. Cinchona bark, and more so pure quinine, are the only effective remedies, and, if they were less expensive, millions in India would be benefited by them. The natural forests of the more valuable kinds in South America are approaching exhaustion. Experience has sufficiently proved that some of the most valuable species succeed well on the Neilgherries, in Ceylon, and on the lower hills of British Sikkim, and that they yield an abundance of quinine. But the localities where the best kinds can be grown in India are limited, and it would be well if as much of the available area as possible were planted with Cinchonas. It has been said that India owes more to the Portuguese than to any other nation in the matter of plants and trees introduced from abroad, and certainly the papaya, guava, custard-apple, cactus, pine-apple, and agave, all naturalised more or less directly through their agency, bear testimony, in almost all parts of India, to the skill and activity of the early Portuguese settlers. On the other hand, it is due entirely to British enterprise and energy that the Coffee tree, which was introduced about a hundred years ago by a Mussulman saint from Arabia into South India, and first cultivated on the Bababooden hills, in Mysore, is now grown in numerous extensive well-managed plantations; that Tea, the existence of which in India was hardly known forty years ago, has become an important, annually-increasing article of export; and, lastly, that the Cinchona tree was successfully intro-

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duced from South America, and promises to be one of the greatest blessings to the people of India.

So much will be clear from these remarks, that in the climate of India the luxuriance of arborescent vegetation is a sure index of moisture. A glance at the map might tempt us to go further, and to say that the limits of distribution of the different species in India seem to depend in a greater degree on moisture than on other climatic conditions. The northern limit of Teak, it is true, seems to be more influenced by the temperature of the cold season than by moisture. Natural Teak forests are not found where the mean temperature of the three cool months is considerably less than 60°, though the tree will stand occasional night frosts, which are not uncommon in some of the valleys of the Satpoora range. But no teak is found on the Aravulli hills about Ajmere, though that place has a mean temperature of 65° during the cold season. In this direction it apparently is the want of sufficient moisture which has limited the further extension of the species by natural means. By cultivation, this, as most other trees, has been extended far beyond its natural limits; numerous fairly-growing teak trees are found in gardens in Bengal, the north-west, and even in the Punjab; a teak plantation has been commenced in Sikkim; and it has been proposed to cultivate this valuable tree on a large scale in Assam. Within certain limits the teak tree does adapt itself to different conditions of soil and climate; but limits there are, and, as far as our present knowledge goes, it thrives best with a rainfall above 30 inches, a mean temperature during the three cool months of between 60° and 80°, and during the rest of the year between 70° and 90°. Teak is spread over a great part of the dry belt of Southern India, but only as poor coppice, yielding a scanty crop of poles and rafters, and never attaining any large size.

The Sal tree is found in two large belts, one extending along the foot of the Himalaya range from Assam to the Sutlej river, with a few outlying patches beyond, and the other occupying the eastern part of Central India. The Sal depends, to a much greater extent than the teak, on certain peculiarities of soil; it is mainly found on sandstone, conglomerate, and gravel, but does not thrive on the heavy clay-soil which overlies the extensive trap-rocks of the Deccan and part of Central India, and this peculiarity may have a considerable influence in limiting the area of its distribution. It stands more cold than teak, but it does not seem to thrive with less than 40 inches of rain.

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A far more limited range of distribution has the Caoutchouc tree (*Ficus elastica*), a tree which is frequently grown in conservatories and drawing-rooms in this country and on the Continent; so much so, that in Germany it goes by the name of the Berlin weed. Its milky juice yields a description of India-rubber, not equal to the excellent Para rubber, the product of an altogether different kind of tree in Brazil, but which may be capable of improvement by a more careful method of collection. In India this Caoutchouc tree has only been found in the moist forest skirting the Eastern Himalaya from Sikkim to Assam, and at the foot of the Khasia and Cachar hills. A humid atmosphere, and equable temperature throughout the year, seem to be the principal conditions of its free growth. The mean temperature in the stations nearest to the caoutchouc forests is between 60° and 65° in the cold season, and 80° and 85° in the three hottest months.

The conditions of existence under which the Deodar grows at the north-western end of the Himalayan range are altogether different. To begin with, it demands a certain elevation; as a rule it does not thrive in the north-west Himalaya under 4000 feet, but it ascends to 10,000 and at times to 12,000 feet. As to mean temperature, a range between 35° and 50° in the cold season, and 65° to 75° during the three summer months, seems to suit it best. As regards humidity, the Indian cedar does not go beyond certain limits of drought and moisture. In the Sutlej and other Himalayan valleys it disappears where the arid region commences, although the conditions of soil, temperature, and elevation are not unfavourable. Again, it is wanting in the Eastern Himalaya, where the rainfall exceeds 100 inches. The Deodar is so closely allied to the Cedars of Lebanon, the Taurus, and the Atlas mountains, that botanists find it difficult to keep them distinct as species. A close comparison of the climatic conditions under which these western cedars grow, with the climate of the north-west Himalaya, may lead to interesting results regarding the history of the spread of these beautiful and useful trees. It is not, however, climate, soil, and the action of man in historic times alone, which determine the area over which plants or trees are actually found at the present time; other far more remote causes have been at work, the study of which forms the most interesting part of botanical geography. The forester, however, has to take things as they are, and to him the most important point is to ascertain the conditions most favourable for a vigorous growth of those trees which pay best, and which yield the largest

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quantity of timber and other forest produce within a certain time on a given area.

The other trees indicated on the map, Babool and Sandalwood, are satisfied with a moderate supply of moisture. The Babool tree is spread over a great part of India, but it is wanting or does not grow well in the moist zones. Without irrigation it seems to grow best under a rainfall between 15 and 60 inches; and where moisture is supplied from below, it thrives well in the driest parts of India. The Sandalwood is at home in India mainly in the southern dry zone: it demands a hot dry climate. In gardens it is grown in many of the more humid districts, but the heartwood is less fragrant and less valuable. The tree is not, however, limited to India; it is also found in the Indian Archipelago, and there are other species of the same genus yielding sandalwood in the Fiji and other islands of the Pacific, from whence it is largely exported to China.

What has here been advanced makes it sufficiently clear that there exists an intimate connection between the climate of India and its forest vegetation. The practical aspect of the subject, however, has not yet been touched upon. Well may the question be asked, why we should trouble ourselves concerning the maintenance and improvement of the forests in a country which has a civilisation many centuries older than our own, which has existed and has maintained an immense population so long, without feeling the want of any systematic care of its forest lands. I must ask the reader at once to dismiss the idea that by preserving and improving the forests of India we may hope materially to change and improve its climate. It is a widely spread notion, entertained by many writers who are competent to judge, that forests increase the rainfall, and that the denudation of a country in a warm climate diminishes its moisture. Much of what is known regarding the history and the present state of the countries round the Mediterranean seems to support this theory, but it has not yet been established by conclusive evidence. In India, where, directly or indirectly, the success or failure of the crops depends on rain at the right time and in suitable quantity, it is natural that the conservancy and improvement of its forests should have been regarded as one of the means to be employed for a better regulation of the rainfall. Many remarkable facts are recorded, which seem to show that in comparatively recent times, the denudation of certain tracts has been accompanied by changes in husbandry, indicating a diminished or less regular rain-

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fall. There is not yet, however, sufficient evidence to prove that a material deterioration of the climate has been the result of denudation in any part of India. Much less has it been established that by preserving and extending the forests we may hope considerably to increase the rainfall. Not that a country covered with forests is not under certain circumstances likely to have more frequent and heavier showers than a hot barren desert, but there is no prospect of our carrying out in India any measures on a sufficiently large scale to effect any appreciable improvement of the climate. In the moist zones, and in a large portion of the intermediate region, the country would not benefit if the total annual rainfall was increased. The land would undoubtedly produce more frequent and heavier crops if we could by any means more equally distribute the moisture over all seasons of the year. The seasons in India, however, are regulated by the dry north-easterly winds which prevail during one half of the year, and the wet south-westerly currents which reign during the other half; and these again are the results of the rotation of our globe, the position of the sun, and the distribution of land and water on our hemisphere, and of other cosmic phenomena which will not be affected by any forest cultivation in India. What might be extremely useful would be to increase the rainfall in the arid and dry regions, where the cultivation of the land to a great extent depends on irrigation, and where a dry season causes famine of the most terrible character. If by any means we could increase the atmospheric moisture in the drier districts of the Deccan, in parts of Mysore, Rajpootana, Sindh, and the Southern Punjab, these countries might maintain a dense population in prosperity. But of such improvements all prospect is denied to us. If it were possible to cover any large proportion of these dry districts with forests, the stratum of air overlying the top of these forests would undoubtedly be cooler and moister, and during the south-west monsoon this would certainly bring down a few additional showers. But it is not possible. Save along the banks of rivers, there is no moisture to raise and to maintain such forests, which I fear will remain a fond hope not to be realised in our time. By preserving and improving the woods along the coast of the western ghats, it has been stated that the rainfall in the dry country beyond might be increased. As far as our knowledge reaches at present, it seems probable that heavy forests along the edge of the ghats, and in their vicinity, have the effect of increasing the local fall of rain along this belt; but if this is the case, the westerly winds

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will be drained of their moisture, even to a greater extent than if there were fewer forests, and there might possibly be less condensation and less rainfall in the dry country beyond.

Nevertheless, there is no doubt that every grove and every group of trees in the dry and arid regions of India is a blessing, the value of which cannot be estimated too highly; and though we may not be able to raise extensive forests in these districts without irrigation, yet a great deal can be done by improving and extending the wooded tracts along the borders of the dry country. Save in the most arid districts, mere protection from cattle, cutting, and fires is sufficient to produce, not, it is true, dense forests, but brushwood and grass, which certainly, in a small way, serve to keep the ground cooler and moister. There is no country in India where the beneficial effects of mere preservation of brushwood tracts in a dry climate may be better studied than in some of the native states of Rajpootana. Such chiefs as the Rajah of Kishengurh, the Thakoors of Bednore and of Humeergurh, and their ancestors, have set a good example, which the forest officers of the British Government will do well to imitate.

Whatever views may be held regarding such slow, gradual, and limited effects of forest growth upon the climate, there is no doubt that, in a hilly country, forests enable us in many cases better to husband the existing water supply for irrigation. Whether the drainage from the hills is collected in tanks and artificial lakes, as is the case in Rajpootana and Mysore, or whether it is employed to feed canals, to carry water, fertility, and wealth into distant districts, the object is the same, to utilise to the utmost the water supply available during the year. Experience in India and elsewhere has proved that where hills are bare, the rain rushes down in torrents, carrying away loose soil, sand, and stones, silting up rivers and canals, breaching or overflowing dams and embankments; but that where the hills are covered with meadows, fields, or forest, the superficial drainage is gradual, the dry weather discharge of rivers regular, the springs better supplied; in short, all conditions united to ensure the more regular and useful filling of tanks and canals; and in many cases the attainment of these objects is in itself of sufficient importance to justify measures for the preservation and improvement of natural woodlands, and for guarding against the denudation of hilly tracts. The preservation of forests may be made necessary by other objects of a cognate nature; for instance, in order to protect roads and bridges in hilly tracts, to guard against landslips, to pre-

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vent the formation of ravines, the silting-up of rivers, and other mischief which may follow the denudation of hilly tracts.

Nor is it at all impossible, that in some cases the preservation and extension of arborescent vegetation may have a beneficial effect upon the sanitary condition of a district. The late unhealthiness of Mauritius has generally been ascribed to the gradual denudation of the island; and public feeling there has been so strong upon the subject that legislative measures have been proposed to facilitate the re-foresting of the waste lands. Too much importance must not, however, be attached to the value of forests in India from a sanitary point of view. The district of Rutnagerri, which is situated south of Bombay, between the coast and the ghats, has been densely inhabited for centuries; and in consequence mainly of the practice prevailing in the Concan, of manuring the fields with ashes of leaves and branches, the whole district has gradually been denuded of trees, save groups of pollards, which are annually lopped for manure, groves of palms, and fruit trees in gardens. Yet this district is proverbially healthy; more so than the adjoining British districts, Tanna and Colaba in the north, and Canara in the south; nor is there any proof that the rainfall of the Rutnagerri district is less than it ought to be with regard to its position on the coast. Nevertheless, even here denudation has done serious mischief. Several of the short tidal streams of this part of the Concan, which were navigable in former times, have gradually silted up, and are now useless, except for very small craft.

Beyond all doubt, however, forest conservancy in India has become necessary in order to meet the growing demands for timber, wood, and other forest produce. Under the influence of peace and security, which all parts of the country are enjoying under British rule, prosperity is increasing rapidly in most provinces. The peasantry of entire districts, who have hitherto been content to live in miserable huts, desire to build good substantial houses and to use better furniture. Hence an increased demand for bamboos, wood, and timber. In certain forest tracts the watershed of the timber trade has entirely changed since the American war has stimulated the export and cultivation of cotton. From the forests of north Canara, the former export of timber was all seawards, and fortunately it was not of great importance, and has not exhausted the forests. The export inland was trifling. Since the American war, however, a considerable demand of timber and bamboos for the cotton producing tracts east of Dharwar has sprung up, and a brisk trade is now

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carried on in that direction. Similar changes in the lines of export have taken place in the Kandeish Dangs, and elsewhere in many places. The rapid construction, within the last twenty years, of railways, canals, and public buildings of all descriptions, has created large demands for timber and wood. Although a considerable proportion of the railway sleepers laid on the Indian lines were brought from Europe, the demand in India for this item alone has been so heavy, that within the last fifteen years extensive forest tracts have been denuded of nearly all their standing marketable timber, to furnish railway sleepers. In every respect, therefore, the drain upon the resources of our Indian forests is heavier now than it was formerly, and is likely to remain so; and unless the small extent of remaining valuable forest is carefully managed, with a view to its regeneration, there will certainly be difficulties hereafter. For the law that an increased demand will always produce an increased supply does not hold good when the supply requires one hundred years to become available.

It is not, however, timber only the permanent supply of which we must endeavour to secure for the benefit of coming generations. There seems no prospect of finding coal in sufficient quantity in North-Western India. Railways and steamers in the Punjab and Sindh burn wood, and will probably continue to do so. At the same time, the demand for fuel in the towns and villages of Northern India will increase. Hence the necessity of extensive plantations, and of careful management both of the scanty woods on dry ground, and of the more productive forests along the banks of the rivers. These are the future requirements of India in this respect, and they must always hold the first place in the consideration of public measures of this nature. For, after all, if it were not for the benefit of the people of India, there would be no reasonable ground for undertaking the arduous task of preserving and improving its forests. On the other hand, the interests of trade may justly claim to be heard in this matter. Sandalwood, cutch (the produce of *Acacia catechu*), caoutchouc, lac, teak timber, and numerous other kinds of forest produce, are important articles of export from India, and the maintenance of a sufficient supply to satisfy the requirements of trade is a matter of great moment. Nor does the export of these articles benefit the merchant only; it adds largely to the prosperity of the people of India.

These are the principal reasons why forest conservancy in India is necessary. A more difficult question is, how the objects we have

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in view are to be attained. Forests, like all other landed property, can be either in the hands of the State, of towns, village-communities, or other public bodies or corporations; or, lastly, in the hands of private individuals. There are thus two ways of accomplishing our object. Either the State must, by legislation, subject all forest property to a certain control for the public benefit, reserving to itself the right of compelling the proprietor to manage it in accordance with certain rules and prescriptions laid down from time to time, as circumstances may require. In many European countries this plan has been more or less successfully pursued, and in most is still maintained with regard to forest land which is the property of municipalities, villages, and public corporations. In France, for instance, the management of all these classes of forests is under the control of the State Forest Department; and, upon the whole, the system works well. Similar arrangements exist in Prussia and in other German countries. Private forest property, however, is practically free in most European countries. Nearly all European States hold large forest domains in the hands of Government, and this makes it possible to maintain an efficient body of public forest officers, with practical experience, competent to manage or to control the forests of other proprietors.

Italy has, it is true, of late years pursued a different policy, but its success is doubtful. The greater portion of the State forests and of the ecclesiastical estates, which might have been formed into State forests, have been sold; and the project of a law, placing such tracts of private and other woodlands, as may from time to time appear necessary, under the control of the State forest officers, has repeatedly been discussed, but as yet without any practical result.

In India, everything tends to show that the State must endeavour to retain as many of the more important forest tracts as possible in its own hands. In the first instance, this seems the only way of forming an efficient body of forest officers with practical experience. In the second instance, the control of forests in the hands of other proprietors will, in India, always be a peculiarly difficult matter. Not that the formation of village forests, and their regular management under the control of State forest officers, would not be a most desirable object to aim at. Certainly, the advantages of well-managed communal forests are great. The public property thus created cannot readily be converted into cash, and wasted by an improvident generation. It yields a fixed and certain annual

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revenue, available for roads and other public improvements. In many parts of continental Europe, long experience has shown that well-managed communal forests increase the prosperity of communities and their inhabitants, facilitating at the same time the development of healthy municipal institutions. And though at present it would be premature to expect the people of India to appreciate the advantages of such institutions, the time will certainly come when the importance of proposals tending in this direction will be recognised. But so much seems certain, that the State ought not to undertake the control of forests of other proprietors until its own forest officers have the needful practical experience, and are competent to manage them to the best advantage.

The general principle, that the more valuable forests should as far as practicable be formed into State forest domains, has, after much opposition, gradually been acknowledged in most provinces of India; and in some provinces the process of demarcating these State forests has made considerable progress. From a late return, I gather that the area of the reserved forests in the provinces under the government of India, outside those of the Madras and Bombay Presidencies, but including the forests leased from native princes, is estimated at 9800 square miles, or 6,200,000 acres. In India, these forests are called "reserved forests," as they are formally reserved from sale, except by the express permission of the Supreme Government. By way of comparison, I may mention that the Crown forests of England cover 112,000 acres, the State forests of France upwards of 2,500,000, and the State forests of the kingdom of Prussia upwards of 6,000,000.

The area here given for India, however, includes a large extent of forests which are not the property of the State, but which are only leased for a definite time from native chiefs and princes. It also includes a large extent of woodlands, which have not yet been finally demarcated, or in which, though the State may be the proprietor, the surrounding agricultural population exercise rights of pasture, of cutting wood and timber, and, in some cases, of clearing ground for cultivation. In a few provinces, such as Sindh and the Central Provinces, circumstances were favourable at the time of demarcation, and the State acquired at once absolute proprietorship of these forest lands free of all prescriptive rights. In other provinces, the gradual adjustment and extinction of these rights, which materially interfere with the protection and systematic management of the forests, will be a work of time, which will require much care,

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patience, and conciliatory treatment of the people concerned. In this, as in other matters relating to the administration of forests in India, we are guided by the experience gained in this country, and on the Continent of Europe, in dealing with rights of commons and other prescriptive rights in forest land. There has been much thoughtless talk, as if the natives of India, in burning the forests and destroying them by their erratic clearings, were committing some grave offence. If the matter is carefully analysed they will be found to have the same sort of prescription which justifies the commoner in the New Forest to exercise his right of pasture, mast, and turbary. Such rights, when the public benefit requires it, must be extinguished; but the wild tribes of India have the same claim as the holder of prescriptive forest rights in Europe to demand that provision be made for their reasonable wants and requirements. The State forest domains in India are thus in course of formation only; the greater mass of them is in a poor and exhausted state; many are burdened with heavy rights of pasture and other prescriptive demands. For many years to come they must be worked most sparingly; considerable sums must be expended on the demarcation and survey of boundaries, on roads, the clearing of streams, on plantations, and other improvements. At the same time, all these operations and the protection of these extensive tracts require large and expensive establishments. These are the reasons why the administration of the public forests in India has not yet within the short period of its existence yielded any large surplus revenue to the State. The gross income of the Government forests in British territory has within the last three years fluctuated between L.420,000 and L.465,000; but the charges have been high, and the highest net surplus of the year has amounted to L.160,000 only, and in another year fell as low as L.86,000.

Nevertheless, there is no doubt that, financially also, the formation of State forests in India, and their methodical management, will eventually be an important source of revenue and strength to the Government. In this, as in all matters, the first commencement has been difficult. The idea of providing for coming generations may to many appear an unnecessary waste of time; but when the present generation begins to derive substantial benefits from these measures, then their value will doubtless be fully recognised.

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under great obligations by his continued exertions on behalf of the Society.

Financially, the Society has had a very fluctuating experience.

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For some years the income was extremely small. The following table, compiled from the records, shows the receipts since 1858 :—

1858–59,	L.53	1866–67,	L.140
1859–60,	100	1867–68,	59
1860–61,	50	1868–69,	103
1861–62,	31	1869–70,	163
1862–63,	31	1870–71,	192
1863–64,	57	1871–72,	133
1864–65,	48	1872–73,	187
1865–66,	73		

There is reason to hope that, with growing popularity and an increasing number of members, the income will now steadily rise, as the funds are still inadequate to meet many desirable objects connected with our Society, such as the wider circulation of our Proceedings, the formation of a library, and grants for scientific inquiry.

The examination of our printed Transactions proves that a considerable change is taking place in the subjects to which our attention is directed. During the first four years I find that out of 25 papers and reports the great majority were on purely practical subjects connected with the routine duty of a British forester, such as drainage, pruning, thinning, fencing, and the like; but a wider scope has lately been given to our efforts, and papers have been recorded on the influence of climate and soil, the growth of various introduced trees, improved instruments, continental systems, Indian forestry, and collateral branches of science.

The estimation in which our Transactions are held may be inferred from notices in journals, and from the following letter of Dr Brandis, Inspector-General of Forests to the Government of India, a very high authority on forest science and administration, with whom I was long associated, and from whom I have often derived valuable information :—

"I write to express to you my obligations to the Scottish Arboricultural Society for sending me their Transactions, which contain numerous most interesting and instructive papers. I beg to suggest that copies of these volumes be sent to the leading forest schools and associations of foresters on the Continent. I feel assured they will be received with pleasure, and this may lead to a mutual interchange of publications. I shall be obliged by your conveying to the Council the expression of my cordial wishes for the prosperity of the Society."

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I feel assured that it will be mutually beneficial to comply with the request to send our Transactions to the officials and associations named by Dr Brandis, and to cultivate as far as possible a free interchange of experiences. This will tend to fulfil the object of the deputation which it was proposed last year should visit the Continent, and we may hope to receive in Scotland some of the eminent foresters of those countries, to whom we could show much that would be highly interesting and instructive.

Among the materials for an address on the progress and state of forestry in Britain I specially notice a small volume of Reports on Forest Management in Germany, Austria, and Great Britain, lately printed by order of H.M. Secretary of State for India (Duke of Argyll). The table of contents indicates details of the system adopted in various countries. Captain Walker, who spent some time in the Scotch forests of the Duke of Athole and the Earls of Mansfield and Seafield, describes their management, and also fully explains the system of forestry in operation in some States of Germany and Austria, which he studied when in Europe on leave from India. Mr Gustav Mann contributes a paper on the silver fir and spruce forests of the Hartz. Mr G. Ross gives an account of the laws and regulations of the village and ecclesiastical forests in the province of Hanover, and also a paper on plantations of Scotch fir on moor-pan soil in Germany. Mr J. W. Webber writes on the natural oak forests of Sussex, and Dr Brandis concludes the volume with some excellent suggestions on the professional studies of Indian forest officers at home on leave. Selections from this volume might with advantage be reproduced in our Transactions. The following passage relating to Scotch fir forests in Germany I may quote by way of example :—

"In the plains of north-east Germany, Hanover, Brandenburg, Saxony, the extensive Scotch fir forests, which are mainly regenerated by sowing and planting, should be visited. Insects have been the great difficulty in many of these tracts, and in some cases an attempt has on that account been made to revert to natural regeneration. In the eastern provinces of Prussia forest fires have been most destructive. The Scotch fir forests of Franconia (Steigerwald, Hauptsmoor, near Bamberg) are principally maintained by self-sown seedlings. In these forests the successful employment of an underwood of beech to improve the growth of the Scotch fir should be noticed. In the forest tracts round Kloster Ebrach the results of this system are seen in the shape of

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magnificent stems, with dark red heartwood, which fetches a higher price than oak. A different sort of management may be studied in the sandy alluvial plains of Hesse-Darmstadt. The forest crop (Scotch fir, and sometimes oak) is made to alternate with cereal crops. This remarkable system should be studied in the grand ducal forest district of Viernheim, where it is in force on an area of 5000 acres. The forest crop is cleared and rooted up, and the ground is then planted in lines with Scotch fir, on better soil, mixed with oak (the Scotch firs acting as nurses to the oak), and potatoes are planted between the lines. The second year a crop of rye, and then two more crops of potatoes and rye are taken. In this manner the young plants are sheltered during the first four years of their existence, and the ground is kept clear of grass. Under the peculiar circumstances of the locality, deep but moist sand, much exposed to late frosts in spring, this system answers admirably, the growth of the trees is better than where no crops are taken off the ground (in the vicinity), and in addition there is a surplus from the agricultural part of the operations. Forest officers from Burmah will be glad to see this system, which is analogous to what was introduced in 1864 in the teak plantations near Toungoo."

On the 24th of March 1873, a paper was read by Mr William Brown, at the Institution of Surveyors, London, on "Beech Woods and Larch Plantations," which was followed by an interesting discussion recorded in the Transactions of that Society, vol. v. pt. ix. The remarks of the various speakers (Messrs William Menzies, John Clutton, &c.) contain the testimony of practical men as to what they have seen and practised themselves, but very contradictory statements are recorded. For instance, Mr Clutton, a high authority, averred that "his experience of late years in England and Scotland led him to believe that the larch is a doomed tree;" while Mr Brown and Mr Sedgewick think that the planting of larch in suitable soils should be encouraged, and that it will pay remarkably well. When persons of long experience, entitled to every consideration, enunciate opinions so opposite, surely it should be our endeavour to test the matter and to expiscate the truth, dealing with the question on scientific principles and in a scientific manner.

With regard to the influence of the denudation of trees on the rainfall of North Britain, which has been repeatedly alluded to at our meetings, I may mention that a brief preliminary report of the Committee's proceedings was read at the British

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Association at Bradford in September. Two localities were selected after much correspondence, and in one (Carnwath) the recording of systematic observations has commenced. The subject is confessedly a most difficult one to investigate, and I would caution you against forming conclusions from the experience of one or two years, and not to expect much from the observations in one locality.

In regard to this inquiry, "Man and Nature," * by the Hon. G. P. Marsh, United States Plenipotentiary at Florence, is a most interesting and valuable work, treating the subject broadly and generally, recording many remarkable facts in history and physical geography; but the author does not attack the subject *instrumentally*, or enter upon a rigid inquiry based upon *numerical* data. Indeed, our best meteorologists admit that we are not in a position at present to grapple with the problem directly by instrumental observation. For, from the capricious distribution of the rainfall at all times, many years must be allowed to elapse (at least twenty or thirty years) before the influence of forests on the rainfall can be unmistakably indicated from the data collected by gauges, supposing even that rain gauges are planted over a district in positions suited for the proper investigation of this question.

The only satisfactory means of investigation that can be recommended as likely to lead to successful results is to consider it as part of the more general question, viz., *the influence of forests on climate*, particularly on the two great elements of climate, temperature and humidity. This branch of the question has not been investigated with so much success as has attended Mr Marsh's inquiries into that part of the problem with which he deals. Indeed, the examination of the temperature and humidity can only be said to have commenced. In France, Becquerel has given a good deal of attention to the question, and published the results of his investigation concerning it, but these are unfortunately unaccompanied by the requisite details, and the conditions under which the temperatures were observed are not stated with sufficient exactness. Signor Rivoli in Italy, Paul de la Cour in Denmark, and some others, have done a little in the investigation of the subject. But Mr Buchan, Secretary to the Scottish Meteorological Society, informs me that the most systematic series of observations set on foot in the prosecution of this inquiry are those of Ebermeyer in connection with the forest school at Aschaffenburg in Bavaria, of which the results are regularly published.

* London 1864, and Florence 1870.

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The ground already gained is valuable chiefly as being suggestive of what may be expected in future, and the most likely methods to be adopted in prosecuting the inquiry. So far as concerns results already obtained, however, extremely little is positively known.

The rapid rise in the price of coal, to which I alluded last year, has attracted the attention of the Legislature, and a Coal Commission Blue Book has appeared, while scientific opinions on the state and prospects of our mineral fuel supplies have during the past year been communicated from many quarters. In a country where the winter is long and severe, the supply of fuel at a moderate price is as essential to the common welfare as a sufficient supply of food. Indeed, every man who has any regard for the comfort of the poorer classes must be watching with interest all the schemes and discussions for saving fuel. And in what way, it may be asked, is this connected with the work of foresters? When we see samples of peat compressed by various processes exhibited at the Society of Arts, and notice that four companies with large capital have been formed in different parts of Great Britain for the purpose of manufacturing peat-moss into a useful fuel, it seems certain that the branches and fragments of our woods, which are now in many places unsaleable, may be disposed of to advantage. This would, of course, greatly stimulate the planting of rocky hills and waste places not now utilised, where trees might grow with very little attention. I have endeavoured to make calculations to prove the practicability of firewood sales in Scotland, but so much depends on soil, climate, growth, and proximity to a market, that it is not possible to give reliable figures. That the value of firewood will rise much may reasonably be doubted on account of the rapid and cheap means of communication, and because the dearness of fuel would operate as a check to productive industry. In country villages where a supply of firewood is available, wood is still used for firing, and in large towns faggots are in great demand. But from the analysis of manufactured peat by Clayton's process, it seems probable that this article will come into more general use than wood fuel. The estimated cost of this peat at the manufactory is about 8s. per ton. A recent analysis which has been made shows that it gives 8000 cubic feet of gas per ton.

Many insects are most injurious to forest trees, and comparatively little has been recorded concerning them. In this country it is known that our most useful trees have their particular enemies.

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Ash is assailed by *Hylesinus fraxini*, elm by *Scolytus destructor*, larch by *Bostrichus laricis*, Scots fir by *Hylobius abietis* and *Hylurgus piniperda*, willow by *Trochilium crabroniforme* (the lunar hornet sphinx), and others. The plane, maple, and walnut suffer less severely. Much interesting and reliable information about insects is given in Selby's "British Forest Trees" and Loudon's "Arboret. Britannicum."

In like manner, incalculable mischief is caused in India by the destructive agency of white ants and other insects. One insect (*Bostrichus*) reduces the bamboo to an impalpable powder; another infests the seeds of tamarinds (*Calandra tamarindi*), which crumble to dust; and the coffee-bug (*Coccus coffeæ*) has been destructive to coffee estates in Ceylon and Coorg. In some parts the carpenter bee (*Xylocopa*) bores through posts, rails, and beams, occasioning serious injury to houses. In visiting wood depots one cannot fail to observe the damage caused by timber-eating beetles, and it is important to trace out the history of these destroying agents and to apply a remedy. Any observations upon the natural history, economy, and proceedings of such insects as are injurious to trees (living or dead), and any detail of experiments made for the destruction of the insects, or for preservation from their attacks, might be of much practical utility. Figures of the insects in their different states, and specimens of the wood showing the effects produced, would enhance the value of such communications. The highest authorities known to me in this country regarding insects which attack forest trees are Mr James Hardy, Penmanshiels, Berwickshire, and Mr Albert Müller, Norwood, London,* who have devoted themselves to this branch of entomology, and whose opinion might be valuable to those whose trees are suffering from the depredation of insects.

This leads me to dwell for a moment on the importance of quickening your power of observation. The forester, like the farmer, has to watch the seasons, the destructive effects of insects, and many incidental circumstances, including the rise and fall of the markets, which hasten or retard his felling operations, the profit or loss being materially affected by his shrewdness and judgment in availing himself of all advantages.

In selecting trees to be felled, the condition and qualities of each individual tree have to be examined as a farmer studies the peculiarities of his cattle. Some trees are of a more rapid growth than others; these should be left as long as this quality shows itself,

* Appointed Director of the Zoological Garden, Basle, Switzerland.

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and such as have increased but little should be selected as the first disposable.

I believe it is common to find men engaged in forestry more enthusiastically attached to their profession than in any other calling; they are always surrounded by nature, which ever presents some new aspect to interest and delight those who study her. And here I would suggest that the long evenings of the coming winter would be well spent in acquiring some knowledge of the "*scientia amabilis*," illustrations of which surround us here. By a knowledge of the structure and properties of the plants you see daily in the exercise of your calling, the pleasure enjoyed in your work would be vastly enhanced. The study of the structure of our common woods with the help of an ordinary pocket lens cannot fail to be both interesting and useful.

You must not lose the opportunity to-day of visiting the Museum of Economic Botany, where you will see some objects familiar to you, and many from distant countries fitted to attract your wonder and admiration. The Pinetum formed under the superintendence of Mr M'Nab contains the finest collection of Coniferæ I have ever seen, and they are arranged so skilfully that a careful inspection cannot fail to prove instructive to such as have already some knowledge of the habits and requirements of this family.

In conclusion, I regret to say that the Society has to lament the loss during the year of several distinguished members. Amongst others, Professor Davidson, Veterinary College; Mr Robert M. Stark, nurseryman, formerly our Secretary, the author of a popular "History of British Mosses;" Mr M. Buist, factor at Tyninghame; and Dr J. L. Stewart, an Indian botanist, who, while Conservator of Forests in the Punjab, submitted valuable reports on forest questions in that province. Two years ago Dr Stewart offered a prize for an essay, to be sent to this Society, on the present state of the cultivation of *Cedrus Deodara* in Great Britain and Ireland, which I regret to say has not yet been competed for. Although Dr Stewart has passed away, the prize is still offered, and it is hoped will soon be won.

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XIII. *On the Natural History of Beetles and other Insects which infest Coniferæ, and suggested Remedies.* By ROBERT HUTCHISON of Carlowrie, F.R.S.E., Vice-President.

The insect world, with its teeming myriads of devouring creatures, varying so infinitely in habits, instincts, forms, and organs, is principally distinguished as to its functions, which may be said to be discharged with a view to great and general benefit and utility to the numerous species themselves, as well as with the object of destroying or removing nuisances which would otherwise deform or possibly infect the earth and its inhabitants. Many insects may, indeed, be said to be the earth's scavengers, the pruners of nature's too luxuriant productions. But while a counterpoise is thus established and maintained for the purpose of checking any tendency to overgrowth in the vegetable kingdom, it not unfrequently happens that by the same agency the projects of man, in regard to the cultivation and use of many staples of vegetable economy, are frequently seriously interfered with, and sometimes altogether marred, by the predacious and destructive attacks of many of the species of this great division of the animal world. The study of entomology, and the consideration of its classification into (1st) insects which are beneficial to the growth of plant-life by destroying others in their larva state, which would prove, if unchecked in population and distribution, most injurious to many trees, shrubs, and plants, and (2dly) insects which are themselves parasitical and inimical to the health and development of vegetable life in many forms, is a subject of the deepest interest to the close observer of nature, and especially so to the student of arboriculture, as well as to every lover of forestry who is practically engaged in that all-engrossing occupation.

It is with the insect world, in the latter of the two subdivisions to which we have referred, that we purpose now to deal, and attention will be mainly confined in this paper to the most prominent and most popularly known species which attack coniferous trees, and ravage no less seriously the newer introductions of this family than they do our common Scots fir and other older and more commonly planted varieties of Coniferæ.

It has been universally observed that trees of the pine tribe, most frequently affected in their young stage by the attacks of insects, are those which are planted in soil previously cropped by

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the same description of trees. This will also be the case even although the previous crop may not have been affected in the least degree by such ravages, thus clearly showing that the cause of the destruction to the second crop does not lie in any sort of infection or transmission of the disease (if so it may be called) from the former occupants of the soil, but rather from the growth and establishment of larvæ in the ground itself, engendered probably by the dry condition of the soil caused by the previous cropping and absorption of the moisture by the numerous roots left in the ground after felling. This theory is supported by the fact, that frequently after thinning young fir plantations insects are observed to attack a district where they had not been previously known. Probably the dried nature of the substratum of soil, intensified by the continued absorption of moisture by the old roots left in the ground, and also by the sprouting of some of the hardwood stools, may afford congenial habitats for the incubation and increase of these obnoxious enemies to the fir tribe. Some authorities attribute the appearance of insects in such cases to the harbour afforded to the little animals in the decaying stumps, and to the weakened growth in the young wood of the trees left in the plantation from the diminution of moisture in the soil; but it appears more probable that the real cause lies in the drier state of the soil itself (independently of the thinning process), affording a suitable and congenial site for the base of the operations of the insects, rather than in the harbour afforded to them by the decaying stumps of trees thinned out. Thinning tends to produce stronger instead of weaker shoots of young wood upon the survivors, and the roots of trees felled will remain for a year or two in a sound condition, whereas the attack of the insects upon the plantation generally commences almost simultaneously with the process of thinning.

In further support of this proposition, it may be stated that in any wood where the attacks of beetles or other insects are observed after thinning, it will be found that, if there happens to be a "*wet bit*" (*i. e.*, a part less well drained than the rest), the trees there are happily exempt from the inroads of the invaders during the earliest stages of their attack. A careful observer of forest economy has already observed this fact in his own experience.* Another fact worthy of notice here, and to which particular reference will be made hereafter, is that these marauders of coniferous plantations seem greatly enamoured of the cut and drying

* W. Tivendale, Scott. Arbor. Soc. Trans., vol. vii. p. 80.

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twigs and branches from early prunings or thinnings. It has been frequently observed that they prefer locating themselves among these cut branches to any other shelter or cover, so long as they find them in a *fresh*, although drying, condition; and they will invariably settle on them rather than on any part of the growing trees themselves. This predilection for shoots in a semi-dry or half-withered state is further attested by the circumstance, that insects which attack the fir tribe invariably commence upon a subject already evincing indications of sickness or decay. This is apparent in woods where no pruning or thinning has afforded them an opportunity of selecting their favourite haunts among felled branches and stools, and in the absence of such they are universally found to select apparently sickly specimens in preference to very robust and healthy plants, the juices of luxuriant and vigorous growths being probably too strong and rank in their vitality for their slower insect development and economy.

One explanation of this generally observed preference of insects of various orders for diseased or sickly specimens of the trees they prey upon, is given by M. Audouin, Professor of Entomology in the Museum d'Histoire Naturelle at Paris, who has closely studied and noted the habits of many insects, and there appears to be good ground for accepting it as authentic and reliable. He thinks that the quasi-incipient decay of the tree is due, not to any inherent failure in the plant-life of the specimen, but to the attacks and boring operations in the bark of the tree caused by the search of the male insects (chiefly) for food, which injures the bark, inducing an unhealthy foliage; into these subcortical borings the female deposits her eggs; and so what we usually ascribe as the primary cause of the tree's sickness is merely the secondary result of the creature's operations, which are really an attack, in the first instance, upon a healthy tree for food. These borings weaken and exhaust the functions of the bark, whereupon the female deposits her eggs in the previously made workings of the male insect, while the act of burrowing and depositing the eggs and of so injuring the tree are commonly supposed to be confined only to trees which previously evinced signs of decay. In the Review Entom. (iv. p. 115), Silbermann also states, upon the authority of Dr Ratzeburg, that the large weevil (*Pissodes notatus*) attacks the bark of young pines with its trunk, and thus renders the trees unhealthy, prior to the female depositing her eggs in them.

The modes of insect attacks upon coniferous trees may be directed

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towards the root, the bark, or the tender young shoots; but, in any case, their preference for the apparently weaker growths and constitutions holds good, whatever may be the method of attack, and whether their victim be a recently planted seedling or a mature tree. They probably, in the first instance, feed on their prey, and then breed in the cavities which their predacious attacks have made.

The season when insects are most injurious to coniferous woods is generally from the beginning of April to the end of June, and again from about the beginning of August till the middle or end of September, in favourable and mild weather or ordinary seasons. Of course, cold or wet weather may affect their operations, but, as a rule, these are the times of the year during which the greatest havoc is committed. Hot and dry summer weather, especially if succeeded by a cold, dry, frosty winter, favours the dissemination and increase of forest-feeding insects. The warmth of summer fosters their breeding, because by its genial influence their period of transformation from the larva state is shortened, and abundance of time is afforded for several broods to mature in succession; and when the following winter is dry, a superabundant number of insects will be found in the ensuing spring; while, on the other hand, should the summer season prove wet and deficient in sunshine, and the following autumn and winter be damp, intensely cold, or snowy, the numbers of insects, whose increase had been previously checked by the adverse summer, will be materially lessened in the following spring, and the destruction to the woods for the time will be proportionately less severe. These remarks principally apply to insects which affect the bark of pines, especially the silver fir (*Picea pectinata*), and confine their attacks to the tree through that medium, selecting chiefly those old trees the bark of which is not very hard. They direct their attack, in the first instance, to apparently weakly or dying specimens, or settle upon felled timber, feeding upon the stagnated sap of the inner bark, to which they bore, by the aid of their sharply-toothed jaws, in a direction slanting upwards as far as the sap wood, and from thence the female hollows out a perpendicular canal about 3 or 4 inches in length in the inner bark, with small niches close together on each side; in these she deposits her eggs, which are small round white objects, and, having covered them up with a slime of her own secretion, the larvæ are hatched in about fourteen days, and they again cut for themselves ramifying passages in all directions, which widen as they proceed, and resemble alphabetical

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letters in appearance, whence the insect has sometimes been popularly styled the "*Typographer Beetle*," or *Bostrichus typographus* (Fabricius). Should silver firs be scarce in the plantation, or the insects be so numerous as to overrun all the trees of that species, they will next attack any other fir or pine that may be most convenient.

The full period necessary for the development of this mischievous little creature is about eight weeks from the egg to the full-grown beetle, and there are generally two broods in each season, the last sometimes remaining (owing to cold or wet weather) concealed dormant under the bark of the tree till the following spring, when they are fully developed. The injury to the silver fir by this insect will thus be seen to be effected by the destruction of the sap-wood, which every arborist is aware will insure the speedy death of the tree, even when otherwise perfectly sound and luxuriant. A short description of this most destructive insect may here be interesting. It is, when full grown, a beetle of from 2 to 2½ lines long, and about 1 to 1¼ lines broad, and hairy. On its first development to the perfect state, and while still under the bark, it is of a rusty yellow colour, becoming darker by degrees, and upon its escape to the open air is of a brownish black; jaws sharply toothed; eyes dark brown; wing-cases deeply punctured, broader behind, deeply and obliquely impressed; the impressions with crescent-shaped margins, which have from 4 to 6 irregular teeth. Thorax and sternum always darker than the wing-cases. The female is distinguished by a thicker abdomen, and is less covered by the wing-cases. The larva or maggot is 3 lines long, wrinkled and white when it leaves the egg, soon becoming yellowish at the head; the back reddish striped; jaws sharp; antennæ short; feet six in number and yellowish. The nymphs or pupæ are white and soft at first, becoming harder and yellower by degrees; they are almost the form of the beetle, only with pale indications of the wings, and with the feet drawn up under the body.*

The bark-boring order of insects are not only very numerous, but they are probably, from their mode of attack, the most destructive of all to whose ravages the pine family are liable. Not only is their process of destroying the inner bark and alburnum very detrimental to the tree, but the myriads of little cell-holes which they cut in the bark, even if their further operations be suspended or prevented, interrupt the course of the descending sap, and admit

* Köllar on Insects, Loudon's Translation, p. 358.

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the percolation of rain and other ungenial weather, which causes the bark to peel off, causing permanent injury to the tree. These bark-burrowers belong principally to the family of *Scolytidæ*, including the genera *Scolytus*, *Hylesinus*, *Hylurgus*, *Tomicus* (*Bostrichus*), &c. They may be distinguished into two classes, viz., those that bore into the heart and body of the trunk of the wood, and those that confine their inroads to the inner bark with its adjacant sap-wood or alburnum. Probably in the case of coniferous trees, the operations of these internal wood-borers are chiefly of the latter description; while there are many insects which attack hardwood timber, and do not confine their inroads to the inner bark, but chiefly burrow into the heart of the trunk itself, rendering even large willows, poplars, oak, elm, and other timber trees so hollow as to be easily blown down. Of these destructive creatures are the stag-beetle family (Lucanidæ); and the very widely-branched tribe of Capricorn beetles, including *Prionus*, *Cerambyx*, *Lamia*, *Stenocorus*, *Leptura*, *Rhagium*, *Gnoma*, *Saperda*, *Callidium*, and *Clytus* (Fab.)

Nor are the ravages of these mischievous creatures apparent and important in the forest and plantation alone, but very frequently the doings of some of them only become known in after years, when trees apparently sound have been felled and converted into timber for construction purposes. This is owing to the length of time sometimes necessary for the full development of the larvæ of many of the species. For example, in the order of Hymenoptera, one genus called *Sirex* is peculiarly destructive to fir timber. In woods in Yorkshire, Stephens reports that whole plantations of firs have been known to be destroyed by the operations of its larvæ under the bark. Two of the most conspicuous and destructive members of this genus are *Sirex gigas* and *juvencus*, both of which have been known to issue from the wood of joists and flooring in houses, after the timber had been wrought up and used for three years.

The other principal bark-boring beetles which affect Coniferæ are *Tomicus pinastri*, *laricis*, *micographus*, *typographus* (already referred to), and *chalcographus*, which are happily, however, less known in Great Britain than in the continental forests. We have, however, more common in this country, the well-known *Hylurgus piniperda*, and the two large weevils, *Pissodes notatus* and *pini*.* Another secondary ailment, which frequently befalls the victim of these bark-

* This insect is said to be common in Rannoch.

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destroying insects, arises from the permanent disruption between wood and bark caused by the innumerable earwigs, spiders, flies, wood-lice, &c., which take possession of the cavities, allured by the exuding sap, no less than by the shelter which the loose bark affords. We have in Scotland little conception of the damage done to forests by these insects. Numerous instances are on record of the extent of their prevalence and ravages. In Germany and Austria, for example, it is stated that 80,000 of the *Bostrichus typographus* have been found in one tree; and so great is the vitality of this little pest that nothing short of fire will destroy it. In the beginning of last century it was unusually abundant in the Hartz forests, and continued in immense numbers for several years—first in 1757, when its ravages were very severe; again in 1769 and in 1783, when the total number of its victims in the forests mentioned amounted to 1,500,000; and the indirect result of its destructive agency was that the industrial pursuits of the surrounding country were seriously crippled, and in some localities actually suspended. Cold and wet seasons, however, in 1784 and in 1789, tended greatly to diminish its numbers. In 1790, however, it reappeared, and again in 1796, when serious fears were entertained for the safety of the few remaining fir trees, which the ravages of former years had spared.*

But in addition to the insects which infest pines by burrowing under the bark, there is an equally numerous and destructive host whose ravages are carried on with similar precision in other ways, by attacking the foliage or the roots of the tree. The well-known substance termed "*honeydew*" is said to be the secretion of a species of *Aphis*. The larch in this country is infested with an *aphis* whose wax-like "*cottony*" filaments are well known, and are often so abundant as to whiten the entire tree, and ultimately (if not removed or checked) to cause its destruction. Then again, there are other deposits caused by the *Aphidæ*, which, although in themselves very beautiful, resembling as they do, when their mechanism is closely examined, fruit, blossoms, flowers, &c., are yet, if allowed to spread to undue proportions, full of danger, and sometimes convey total destruction to the tree. These deposits refer to the secretions of the *Aphis abietis*. The larvæ of several moths also attack fir and other trees by destroying their foliage, viz., *Dendrolimus pini*, *Psiluria monacha*, *Achatia piniperda*, *Bupalus piniarius*, *Orthotœnia turionana* and *resinella*, &c. The three species of saw-fly (*Lophyrus pini* and *rufus*, and *Pamphilius*

* Latreille, Hist. Nat. ix. 194.

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erythrocephala) tend further to swell the number of the enemies of the pine tribe, no less by their annual destruction of the leaves of the year, than by their pertinacity of attack, causing the unfortunate tree to draw upon the undeveloped resources of the next season's supply, to make up the deficiency thus caused in the present. This process, if repeated for a very few years, certainly terminates fatally for the tree. The ravages of the insects we have just referred to are, however, chiefly confined to the continent of Europe, while in Great Britain their attacks, although they have been noticed, are not as yet to any great extent frequent or urgent. They have certainly been known to exist in Great Britain in several localities, but many of them appear not to be indigenous, so it may probably be assumed that their larvæ have sometimes been imported either with seed or upon plants from the Continent. As some of the varieties, such as *Pissodes notatus* (Fab.), already referred to, have of recent years become more common in the United Kingdom, it is probable that it has thus been introduced. This remark applies also to *Acanthocinus ædilis* (Linn.), a little mischief-worker, called in some districts "*the timber man.*"

Thus we see that there are many species of insects whose destructive propensities are confined to the leaves, bark, and shoots of the fir tribe, but there are also others whose operations are directed to the annihilation of the seeds and cones. These are devoured, whether ripe or unripe, with great avidity. To this class belong *Eupithecia togata* (Hb.), whose larvæ are very destructive to the dried seeds of Scots fir, the *Phycis abietella* (Za.), which, in addition to tunnelling into the cones of *Pinus sylvestris*, *Pinus maritima*, and other firs, and destroying their vitality, lodge themselves in the decaying wood of the tree, and thereby hasten the process of dissolution.

The colour of all these insects at one period of their existence so closely resembles the bark and other portions of the tree, that their detection is exceedingly difficult. Indeed, so well is their presence concealed by this means, that their existence upon the tree attacked is first known by numerous spots of resin being seen oozing from the bark. If examined carefully, each of these spots will be found to cover a small aperture, in which the insidious enemy has securely located himself. In this manner whole trees, and ultimately entire plantations, are overrun and seriously damaged.

The list of those insects which attack roots and subsist upon them is fortunately less numerous and important. Their ravages

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are chiefly directed against dead and decaying roots of cut trees. The best known of this class is the *Hylobius abietis*, which may be taken as the type of the whole. It is one of the largest of the British *Curculionidæ*, or weevil family.

The destruction caused to pine plantations in this country by the attacks of the *Hylurgus piniperda*, and the wide area over which (both in England and Scotland) it has been observed, demand more than a passing notice in a paper like the present. It is very commonly found upon the Scots fir and Weymouth pine (*P. Strobus*), and many other conifers, detracting oftentimes by its ravages from their deservedly admired, picturesque, and interesting appearance.

This beetle belongs to the same family as one whose attacks upon the common elm (*Ulmus campestris*) are well known in Scotland—namely, the "*Scolytus destructor*," whose ravages upon the elms in St James' and Hyde Parks, London, created some years ago considerable interest and attracted public attention.

The injury done by the *Hylurgus piniperda* consists in its destruction of the leading shoots of the fir or pine which it attacks. It is incessant in its operations when these are fairly commenced, and the following narrative of the mode and progress of its attack, by Mr John Lindley, will give an accurate idea of the rapidity and devastating effects of this insect's operations:—

"For the purpose of observing its proceedings more narrowly" (says Mr Lindley), "I placed a shoot of the Scots fir under a glass with the insect. In about three hours after, it had just begun to pierce the bark at the base of one of the leaves; its mandibles seemed chiefly employed, its legs being merely used as a means of fixing itself more firmly. Four hours after, its head and thorax were completely buried in the shoot, and it had thrown out a quantity of wood, which it had reduced to a powder, and which nearly covered the bottom of the glass. In sixteen hours more it was entirely concealed, and was beginning to form its perpendicular excavation, and was busily employed in throwing back the wood as it proceeded in destroying it. There were evidently two kinds of this sawdust, part consisting of shapeless lumps, but the greater portion of very thin semi-transparent *lamellæ*, or rather shavings, which presented an invariably regular spiral appearance. I now examined it every day till the fifth, when I found it had emerged through the central bud at about an inch from where it had first commenced."

Of this most destructive pest there are several varieties well

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known throughout the United Kingdom, which may be specified as follows :—

Hylurgus piniperda, Linn.
„ *rufus*, Mars.
„ *obscurus*, Mars.
„ *picens*, Mars.

Hylurgus angustatus, Gyll.=*ater*, Mars.
„ *rhododactylus*, Mars.
„ *ater*, Fab. = *niger*, Mars.
„ *Boleti*, Mars.

They are found principally in June, July, and August, under the bark of the trees they have attacked. Hitherto it seems to have been the general opinion that they molested only diseased or decaying and feeble trees. Some authors even assert (Selby amongst others) that in no single instance have they ever been known to attack a tree in perfect health; but this point we have already referred to in this paper, and we think it is conclusively shown, from recent observations of their habits, that, in their incipient stages of attack, so insidious are their movements, that it is only after a time their presence is detected, and then the vigour of the tree has already begun to decline, and thus the insect is assumed to be *the result* rather than *the cause* of the tree's failure.

As it would be impossible within our prescribed limits to describe and specify *all* the insects which are injurious to the pine family, or whose ravages tend to retard the progress of that interesting class in our gardens and *arboreta*, we can only name a few others whose predatory habits are well known in certain localities, before passing on to notice some of the means of prevention which appear at least feasible, if not thoroughly effectual, for the prevention of the progress of the mischief which these animals occasion.

In some situations the *Ernobius mollis* (Linn.) is frequently found upon both Scots fir (*P. sylvestris*) and *Pinus maritima*. Like the *Hylurgus piniperda*, it lives at the expense of the tree; but Perris (a French naturalist) asserts that it only attacks sickly or ailing plants. To this, as has already been stated, we object, and need not recapitulate the reasons. *Blastophagus piniperda* (Linn.), *Hylastes ater* (Payk.), and *Hylastes palliatus* (Gyll.), which in some places is very abundant, are all extremely destructive.

One of the most fatal enemies of the silver fir (*Picea pectinata*), and which it is to be feared is increasing in many parts of the country, especially in low-lying situations and in deep or heavy soils, is the *Bostrichus typographus* (Fabr.) This insect confines its attacks to the leading shoots of the tree. These it disfigures by

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settling upon their bark, and sucking the juices of the plant till the young wood is literally killed. It spreads with marvellous rapidity over whole trees, and frequently causes total destruction to every young silver fir in a plantation. Young thriving trees of about eight to twenty feet in height appear to be most vulnerable to its attacks. The first appearance of the tree being infested with this plague is to be noticed upon the main stem and under side of the branches and young shoots, where it presents the appearance of a pure white minute substance in small patches close together, which, when microscopically examined, are found to consist of an adhesive cotton-like substance or covering, within which numberless clusters of the eggs of the creature are deposited, and occasionally the insect itself may be found. Gradually the whitened appearance spreads, and with wonderful rapidity the entire bole and branches seem to be dusted over with this downy matter, containing myriads of animals, each busily engaged with its sharp though minute proboscis in tapping the juices of the tree. Their settlement upon any tree will continue for two or three years, till, from first presenting a dwining and unhealthy look, the unfortunate victim falls into a decline from which Nature cannot recover it. The spectacle presented as the progress of decay proceeds is indeed melancholy; the top branches and terminal shoots die first, and gradually, tier by tier, the handsome branches wither off, and in a very few seasons the tree is killed to the ground-line. This insect never attacks the leaves, but confines its ravages entirely to the bark of the young shoots and bole.

A nearly-allied species of *Bostrichus* (*B. laricis*) is very common upon the larch. It does not, however, prove so fatal in its attacks. This insect is commonly and appropriately called "*the larch blight*," from the appearance which it gives the tree when first attacked. The eggs may easily be detected concealed in the crevices of the young bark, and in the hollows around the buds, where they abound in winter time, and are easily discernible by the naked eye, like minute round black grains. They propagate in spring with marvellous rapidity, covering leaves, branchlets, and stem with a small black covering, which gradually whitens as those creatures weave for a covering and protection from rain, a thick, white, viscid, woolly-like substance from their numerous pores, and which is the cause of that sticky and clammy feeling so well known in connection with the larch tree. Happily, as has already been stated, the ravages of this little creature are seldom fatal, although it lives upon the juices

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of the plant, sucked out by means of its sharp proboscis, and according to the moisture and temperature of the season are its attacks more or less severe. For instance, if, by reason of unpropitious frosty winds in spring the opening foliage of the larch should suffer a check, the trees so affected are more likely to be overtaken by the subtle and interminable exertions of its army of little enemies; and after such a season the larch trees present a sicklier hue, and have a more viscid feeling, than in a season when their vitality has flowed in an unchecked tide into a rapidly-developed foliage and blossom.

But while thus presenting the dark side of this picture of Nature in her forest economy, it should also be borne in mind that although a long catalogue of most destructive little insects has been named, there is also a very numerous class of insects which are not only not detrimental to the coniferous or even hardwood trees, but are directly beneficial to them, and especially to the pine tribe, in destroying, and thus keeping in check, other insects which are in themselves destructive, and many of which have been named in the foregoing pages. For example, in the United States of America there exists a small black ladybird, with two red spots on its wing-covers, named *Chilocorus bivulnerus*, which is remarkably useful in destroying bark lice and pine-tree scale. Another small ladybird, *Exochomus gnexi*, which is of a *red colour*, with two *black* spots on its wing-covers, and of similar habits, is also frequent, and deserves protective attention. Many of the ichneumon flies destroy whole acres of caterpillars infesting fir trees; and without the aid of such small predacious and parasitic allies, destructive insects would increase to such an extent as to render all forest labour unavailing. It is well known that while there are multitudes of noxious insects devastating whole forests, there are also many useful little animals which by their operations may be said to act as the good genii of all trees, and chiefly of the coniferous tribe. By diminishing the numbers of the injurious, they check their otherwise too rapid increase; and it is the more necessary to state this fact prominently, because, while the planter sees only the damage which is done by the obnoxious creatures, he seldom observes those little insects and their operations which, unappreciated because unseen, are silently, but not the less surely, engaged in counteracting the pernicious operations of the destructive myriads. To encourage and foster the increase of the innocuous classes of insects should be the aim of every one connected with woodland management or plantations. This

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may, indeed, to a considerable extent, be achieved by preventing the too frequent and indiscriminate slaughter of many species of small birds and other forest denizens; for it is a remarkable fact that the smaller birds feed much more generally (by a wise provision of Providence) upon such insects as happen to be injurious to tree life than upon the harmless varieties.

One of the most useful insects in attacking and destroying many of those allied species which are injurious to the pine tribe is the *Thanasinus formicarius* (Linn.), and the destructive abilities of this small creature are truly marvellous, depositing its eggs not unfrequently in the wood-boring larvæ themselves, as well as in the bodies of many other descriptions of very destructive insects, and also in the larvæ of numerous kinds of destructive beetles which live between the bark and wood of decaying trees.

While it will thus be seen, from the foregoing cursory sketch of some of the numerous enemies of Coniferæ, that their name is truly "Legion," it yet remains that some remedial measures should be pointed out to check the ravages of these incursive hosts, and so preserve the healthful amenity of our beautiful coniferous favourites.

The first suggestion that naturally falls to be offered, with the view of preventing, or at all events of retarding, the attacks of predacious insects, is the entire removal, after felling or thinning any plantation or strip, of all brushwood, refuse, or root stumps, which may be left. Indeed, the instant transport of these outside the wood, and their immediate consumption on the spot, is the first safeguard which can be suggested for healthy plantations. In the case of woods where insect attacks have become apparent upon silver firs, Scots firs, or other common nurses, the immediate felling and removal for burning of the infected victims may tend to stay or lessen the plague. Paring off the grass all round infected trees, to the distance of a yard on each side, and burning the turf along with the diseased plant, is also a good and frequently an effectual remedy.

Where it is practicable, and can be economically done, it is well, before planting any strip or ornamental belt of wood, to plough the ground deeply. This not only turns over the sod and affords less cover for insect life therein, but also affords a deep soft bed for the young roots of the new plantation, and thereby induces a rapid and healthy start, which is always beneficial to a newly-formed wood. Early thinning, *boldly and fearlessly accomplished*, so

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as to admit of a free circulation of air among the young plants, and to prevent overcrowding and other obstructions to the radiation from the earth's surface, and evaporation from the trees themselves in their young state, has likewise a salutary effect in preventing the inroads of insect vermin. This is especially the case with larch plantations, for moss-covered bark, engendered by damp, close, and confined situations and habits of the tree, are fruitful of disease, and harbour innumerable parasitical foes of the pine tribe. When plantations have been once thinned, and are fairly established in growth, it suits very well to allow the *second* thinnings and prunings to lie in the wood for a year after being cut, and then to remove them suddenly in midsummer and burn them up. By this plan a vast number of those insects which prefer settling upon fresh cut and drying shoots and branches are destroyed; but as, generally speaking, in a *first* thinning of any wood, their presence would be rather in the way than otherwise, the plan suggested may be found effectual with a second or third thinning—say when the trees are sufficiently apart, and are probably from 12 to 18 feet high or thereby, so that a free circulation of air can play through them without being interrupted to any extent by the felled branches and other prunings during the first season after the thinning process has been effected. To prevent harbours for insects in hard-wooded plantations, the stools should be cut as *low* as possible, so as to prevent sprouting, and the formation of cluster heads and bush-like forms.

NOTE.—*Coloured illustrations of several of the insects mentioned in the foregoing paper are being executed, and will be given to the Society, by Mr Hutchison, in the next part of the Transactions.*—ED.

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XIV. *On the Present State and Future Prospects of Arboriculture in Yorkshire.* By DAVID TAIT, Forester, Owston Park.

Arboriculture is daily becoming of more importance, not only to landed proprietors, but to the commercial interests of the nation. Foreign timber has lately risen in price about 50 per cent., the result of which has been to raise the price of that grown at home to an equal, and in some cases even a greater amount. It is, notwithstanding, astonishing to find so much ignorance existing in regard to arboricultural matters, both in a practical and a scientific light. Plantations are too commonly looked upon simply as game preserves, not existing for any benefit to the country, or even to the owner, except as affording sport to a limited section of the community. It, however, only requires a slight acquaintance with the subject to show that, while they conduce to a certain amount of sport, they are of infinitely greater importance as a source of revenue to the proprietor, and also to the agricultural and commercial interests of the country.

In the following remarks I will deal with the subject from a practical point of view, and shall endeavour to give a description of the prominent features of arboriculture in Yorkshire.

In this country we must expect to find the proprietor of woodlands consulting his own taste in their management, —that is, whether he will have them kept merely as game preserves, or managed so as to increase the revenue of his estates. If proprietors can be shown that it is their interest to lay out and manage their plantations in a scientific manner and on sound principles, we may expect them to look at the subject more from an arboricultural point of view, and make the consideration of shooting or hunting a secondary matter, so far as their plantations are concerned.

In laying out plantations in this county, as elsewhere, proprietors have been influenced by various motives. Love of sport, ornament, shelter, and profit have all contributed to the increase of woodland property. The result is, that plantations have not always been laid out to the best advantage, or the most suitable trees planted in different soils and situations.

Fences.—The thorn hedge is the most common, the management

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at a certain period of its growth being peculiar to the county—viz., when the hedge becomes overgrown, which it is sometimes allowed to do to form shelter, it is laid over, and a fence about the common height formed without cutting down. This is done by cutting the stem two-thirds through about six inches above the ground, and laying it over at an angle of about forty-five degrees. Small stakes are driven into the line of fence about two feet apart to keep the layer in its place. The cut which has been made is sloped neatly to prevent water from lodging, and left open, so as to give young shoots plenty of air. If a strong fence is required, small rods are twisted in along the tops of the stakes to bind it. Where an old hedge is thin, this sometimes makes a good fence, as the layers fill up the thin places, but the necessity for such treatment is the result of mismanagement at an earlier period. The laying of hedges is not nearly so common now as it was. The bills used for switching or trimming are heavy, and the handles long; sometimes the blade inclines backward at an angle from the handle. When at work, the hedger uses both hands to hold his bill, and works with his face towards the hedge. Sometimes the work done is very neat; often, however, it is of an inferior description. There are matches throughout the county for hedgers trying their skill, but unfortunately in some districts these are being discontinued. Dry-stone dykes are also common in the hilly districts of the county. Iron fencing, too, in all the different styles, is being extensively used.

Draining.—This is an important adjunct of arboriculture; and a large extent of this county being flat, were no artificial means employed to convey the water off the land, a large tract would be marshy ground and stagnant water, instead of fertile fields and luxuriant crops. Even with an extensive system of drainage, the low-lying districts are periodically visited by floods more or less disastrous. Last year (1872), in the month of July, we had in one district 11,000 acres under water, and it was calculated that damage was done to crops to the extent of L.50,000. Had the damage done to plantations been included, the estimate must have been much higher. Many trees of large size were killed, and many acres of young plantations destroyed. What were thriving young trees from 12 to 20 feet high, as well as full-grown specimens, may this year be seen standing leafless. The varieties which have suffered most are ash, wych, elm, and larch. These are the trees we would have expected to suffer most by long exposure to water

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stagnant on their roots. Oak on the same ground was uninjured, which may be from its roots drawing nourishment deeper in the ground. The drainage of ground before planting, and the most careful attention to drains afterwards, are of the greatest importance to the profitable rearing of timber in a district such as above described.

Planting.—It is difficult to say what amount of care has been bestowed on the selection of trees to form existing plantations, without knowing what the primary object of planting may have been. It is a common fault to find existing plantations formed exclusively of oak, which when small fetches a comparatively small price. This may be accounted for by the high price obtained for oak at the time of the plantations being formed, but the object would have been better attained by planting oak at suitable distances for the permanent crop, and filling up between with larch and other kinds. Much of the land, however, is very suitable for growing oak, a wood which, when matured, commands a good price. Although larch will not grow to a large size on clay lands, it thrives well until it is suitable for coal-pit purposes, when a remunerative price can be obtained for it. Young trees for planting are generally obtained at public nurseries, of which there are several in the county, some of large extent. Many proprietors prefer getting trees from Scotland, being of opinion that trees grown under the influence of a northern climate are more hardy, and succeed better after removal. There is a good deal to be said in favour of this view. It is a great shock for trees to be planted out in a bleak situation after being crowded in a nursery; and it appears a sound view, that if reared in a colder and more ungenial climate, they will be less susceptible to the change than if planted out in the locality in which they have been nursed. This, however, only holds good as regards trees of small size, as when plants are large the shorter distance they are removed the better. The operation of planting is generally done by digging pits 4 feet apart, which, in the low clay lands, is the only suitable method. The same difficulty of protecting young trees from the ravages of hares and rabbits exists as in other parts of the country, the only effectual cure being either to have them all killed, or to put wire-netting round the whole of the plantation. For several years after being planted, the young trees are liable to suffer from late spring frosts, the ash and larch being the varieties most affected.

Pruning.—This is a branch of forestry that one does not see

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practised so often in this county as it ought to be, and in many instances where attempts are made to prune, the trees acted upon (which are generally those grown in hedge-rows) are more disfigured than benefited by the operation.

Thinning of Plantations.—Besides all other arguments in favour of early thinning, we have the advantage of a ready market for even the earliest thinnings, which are used by farmers, gardeners, crate-makers, &c., for various purposes, the price obtained repaying the cost of labour. Yet I fear there is a tendency rather to neglect thinning at this stage, and afterwards to do it too severely. On many estates even of considerable size no qualified forester is kept to whom this duty can be intrusted. In such cases a professional timber valuator is called in whenever it is thought desirable to have a sale of timber. To him is intrusted the duty of thinning the plantations, and putting a value on the trees to be cut down. This state of things is very objectionable, and is rendered more so in some cases by a percentage being allowed the valuator on the money drawn at the sale. That is certainly an inducement to get in the largest possible amount of cash, but it may be to the ruin of the plantation, by thinning too severely or removing trees which should have been left. On small estates, where there is not sufficient employment for a forester, some disadvantage of this kind must be submitted to. It is obvious, however, that where a qualified person is in charge, whose professional character depends on the manner in which he discharges his duties, he will take more interest in his work than a person only called in for the time being. It must be understood that the class of persons here spoken of is very different from the landscape gardener, being simply valuators, and not professing to understand the thinning or general management of plantations. Thinning requires much attention in all cases, but particularly in a picturesque or hilly district. There is not only the welfare of the plantation to be considered, but also the shelter of adjoining land and the beauty of the landscape. An important part of thinning here is clearing out the underwood, which can always be profitably disposed of, and, if of hazel or ash, is much sought after. It can be cut with most advantage at from six to ten years' growth. When a quantity of wood is marked for sale, the common method adopted is, in the first place, to have all the underwood cut and sorted, the different classes tied up into bundles, and carried to the roadside. Any plants likely to make good timber trees are left in open spaces,

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or to take the place of trees to be felled. In some cases the underwood is sold, standing, by auction, the purchaser doing all the labour. I do not, however, approve of this method.

Cutting Down and Disposing of Timber.—Felling is generally done by contract by timber merchants' men, or when it is cut down previous to sale by the proprietors' own men. Contracts are objectionable in this work, as the men are less careful in preserving standard trees; but where it is difficult to obtain competent men for estate work, it is the only way of solving the labour difficulty. The methods of disposing of timber may be classed under two heads, viz., selling it standing, and cutting it down previous to its being sold. The first method is much more common throughout the county, and sales of two or three thousand pounds value are effected in this way. There are many objections to this method, but I merely give the system of management practised in the county. Cutting down timber previous to sale is becoming more common year by year, and were proprietors or their managers giving the subject the attention it deserves, it would soon be general. There are various methods adopted for arranging a sale of timber, but selling by auction is the most common. When the timber is felled, sometimes the number of feet, in other cases no particulars, are given, and it is generally more satisfactory to allow purchasers to satisfy themselves on different points. As I have before stated, much of the timber grown is oak, and it would strike a traveller through the county in summer to see a number of trees standing minus the bark and branches. The practice is to strip the trees of their bark, and let them remain a month or two before being felled, to prevent their splitting from the heat of the sun. When there are no branches for the men to stand on when taking the bark off, iron spikes are driven into the tree for that purpose, and those who are used to it can get the bark off very quickly, but I have not found the price obtained repay the extra labour. Trees of large dimensions are certainly much benefited by the operation, and when required for estate use it well repays the extra expense incurred. This work is invariably done by contract, the price paid at the present time being from L.1, 15s. to L.2 per ton, and the price paid for cutting down is from 6s. to 10s. per hundred feet.

On Measuring Timber.—In many districts of the country, when trees are felled, the trunk or bole is sawn through where it becomes knotty, but the general custom in Yorkshire is different, the tree being dressed out as far as it will girth six inches on the side.

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When quoting prices per foot, the two methods make a considerable difference; in the one case there is only the best of the timber, in the other the rough top is included. Owing to felling being done by contract, the timber is measured out very exact, and the contents marked on every tree with a timber scribe. A quarter of a foot is always included in the measurement, and it is no uncommon thing to see a tree containing 80 or 100 feet have an odd quarter or half foot marked on it. This exactness of measurement has arisen from timber merchants buying the trees standing; and bringing their customers to the plantation to select wood to suit their purposes, the measure marked on the tree forming the basis on which the bargain is completed. There is much to be said in favour of exactness in measurement, as it forms a reliable guide for reference at any future time, but it is a duty often very loosely performed. Another feature in timber measuring here is, that no allowance is made for bark except when oak timber is sold standing; the measurement is then calculated under the bark. There is no good reason why an allowance should be made for bark—an allowance which varies in different districts of the country, and which can never be exact. It would be very desirable to attain uniformity in this respect throughout the country. Of course, where an allowance is made for bark, the price per foot will be higher. The class of wood used for pit purposes, in many districts sold by lineal measure, is here sold by cubic measure, so that small trees containing only half a foot of wood are measured in that way. When sold by lineal measure much time is saved in measuring, but the cubic measurement is the most exact.

The Demand for Timber in the County.—Perhaps in no other part of the United Kingdom can higher prices be realised for timber than in the south and west of Yorkshire, to which district this paper chiefly applies. The following list of prices received for timber on an estate in the south of Yorkshire this year (1873) will form the best criterion for judging as to the demand. When comparing prices with those in other parts of the country, the peculiarities in measuring before mentioned require to be kept in view. The prices here quoted were received for the timber lying in lots in the plantation, two or three miles distant from a railway station. Cartage to station cost the purchaser from twopence to threepence per foot, according as the access to the wood was easy or otherwise, after which it was carried on the railway an average of 25 miles before arriving at its destination :—

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Description of Wood.	First Class.		Second Class.		Third Class.		Fourth Class. (Handle-wood & pit-prop size).	
	Years old.	Price per ft. s. d.	Years old.	Price per ft. s. d.	Years old.	Price per ft. s. d.	Years old.	Price per ft. s. d.
Ash	60	2 5	50 to 60	1 9	50	0 10	30	1 9
Alder . . .	—	—	36	1 1	—	—	—	—
Beech . . .	80	1 6	60 to 80	1 3	—	—	—	—
Birch	—	—	36	1 1	—	—	—	—
Elm (Wych) .	60	1 3	—	—	—	—	30	1 0
Elm (English)	120	1 6	60	1 3	50 to 60	0 10	—	—
Larch . . .	—	—	—	—	—	—	36	1 1
Oak	90	3 0	—	—	45	1 1	30 to 36	1 1
Sycamore . .	—	—	60	2 7	40 to 50	1 6	—	—
Spruce fir . .	—	—	—	—	36 to 50	1 0	—	—

The Class of Labourers employed in Plantations.—Assistant foresters as a class are unknown in the county. The working woodmen as mere labourers will compare favourably with those in other parts of the country, but they are deficient in knowledge as arboriculturists. Their highest ambition is to be good axemen, and this undoubtedly many of them are. The work is looked upon too much from a money point of view; consequently, there is a want of interest in the work itself. The evil has grown up under a loose system of management, and the remedy must be a work of time. In Scotland young men enter the profession with a view to push themselves forward to fill head foresters' situations; so that, without looking so much to present wages, they have a stimulus to improvement which would otherwise be wanting. In present circumstances, to obtain such a class of workmen in Yorkshire is impossible, as young men prefer going into public works, where wages are higher. This, no doubt, is partly owing to the low estimation in which our profession is held in the county, caused by ignorance of its principles. We have here intelligent young men being trained as gardeners, and it is from that class—as in Scotland—we should be able to obtain our assistant foresters, who would then, instead of looking solely to the amount of money they could earn, look forward to advancing their social position, and be an example for others to follow in the same steps.

Ornamental Arboriculture.—That there has been, and still is, a considerable taste for planting ornamental trees and shrubs is proved by the extensive and varied collections in the county. It would prove interesting to report on the deciduous and evergreen trees and shrubs on different estates—their variety, height, age, nature of soil, &c.; but a complete list would much exceed the limits of this paper.

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I have now noticed the prominent features of arboriculture in Yorkshire, and it will be seen that much requires to be done even to place it on the footing it has attained in Scotland. I shall now offer a few remarks on the *future prospects of arboriculture in Yorkshire*, which must necessarily be to a large extent speculative. I may, however, observe that there is plenty of room for extending the acreage and improving the management of woodland property. There are large tracts of land, especially in the hilly districts, yielding a very small rental to the proprietor, on part of which, were plantations judiciously formed, not only would they yield a better return for the ground occupied, but by affording shelter to adjacent land would much increase its fertility and productiveness. There are instances in the county of plantations growing at a high altitude, the trees having attained moderate dimensions, the small extent planted alone preventing them from affording much shelter, or giving any appreciable return for the ground occupied. The fact that such plantations do exist is a proof that on a larger scale they would succeed in a greater degree, as it is well known that the greater the extent of a plantation the better trees will succeed in it. Narrow belts and small patches planted on exposed situations are comparatively worthless for shelter.

On some of the inferior low-lying lands, which are liable to frequent flooding, and which produce little but rushes or other inferior herbage, plantations of birch, alder, and willow would prove much more remunerative, especially when such a class of wood realises, as at present, above a shilling per foot for trees of thirty years' growth.

In some circles of agriculturists there is a tendency to talk of land occupied by plantations as so much land lying waste. This, no doubt, is from want of an unbiassed consideration of facts. The great benefit plantations confer on the agriculturist by the amelioration of climate is lost sight of. Before planting a large proportion of his land, a proprietor will always consider the return he is to get for money expended and land occupied. Arguments in favour of reclaiming comparatively waste land by planting have been pressed on the attention of landed proprietors in this country for many years, and although much has been done, much more remains to be done.

The length of time that must necessarily elapse before any return is received for the money laid out in planting forms the chief objection to its being more generally practised. This objection, however, had more force thirty years ago, so far as this county

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is concerned, than it has now. At that time it was only mature timber that brought any considerable price—that is to say, trees that had occupied the ground for eighty or a hundred years; so that a proprietor had no chance of planting and reaping the benefit in his own lifetime—the work done was for the future benefit of the estate. Now, however, the case is different; there is a great demand for pit prop-wood in the country, for which trees are suitable at from twenty to thirty-six years' growth, and larch even at an earlier age. So that on the class of land we have specified, after trees had grown for thirty years, if they were cut down, the price obtained for them would well repay the cost of rearing them, and the rent for the ground occupied,—a fact which may be gathered from the prices quoted at page 143. The advancement made in arboriculture would probably have been much greater, but for the very men who pretended to promote it. So many extravagant expectations were held out which could never be realised; so many calculations based on unsound foundations; so many enthusiastic dreamers, who buoyed up proprietors for a short time by leading them to expect a speedy fortune by planting land which formerly gave little or no return. A short time, however, unfolded the deception, and no doubt caused many planters to abandon the operation in disgust.

As illustrating such writers, I cannot do better than quote from "Cobbett's Woodlands," published in 1825:—"The time will come, and it will not be very distant, when the locust tree (*Robinia Pseud-Acacia*) will be more common in England than the oak; when a man would be thought mad if he used anything but locust in the making of sills, posts, gates, joists, feet for rick-stands, stocks, and axle-trees for wheels, hop-poles, pales, or anything where there is liability to rot. This time will not be distant, seeing the locust-tree grows so fast. The next race of children but one, that is to say, those who will be born sixty years hence, will think that locust-trees have always been the most numerous trees in England; and some curious writer of a century or two hence will tell his readers that, wonderful as it may seem, the locust was hardly known in England till about the year 1823, when the nation was introduced to a knowledge of it by William Cobbett."

It is nearly half a century since these words were written; how far they have been accomplished the reader may judge for himself. They serve to show how little dependence is to be placed in speculative writing, dealing with future events, unless there is a sure basis on which to rest one's calculations.

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XV.—*On the Different Modes of Profitably Disposing of Home-Grown Timber.* By Wm. Gilchrist, Forester, Cluny Castle.

The best mode of profitably disposing of home-grown timber depends much on local circumstances, but there are general rules which ought to regulate all timber sales. Wherever timber is cultivated for profit, the chief consideration is how to produce the greatest amount of timber at the least expense; and, after having produced it, how to dispose of it to the best advantage. The first of these propositions scarcely comes within the scope of this paper; still it is impossible to disregard it altogether, as the age at which a crop of timber is disposed of has a great influence on its profitable disposal. Suppose a plantation where a third or perhaps a half of the trees have arrived at maturity, the question arises, Is it most profitable to dispose of the whole, or only such as seem to be at maturity? Leaving out of view amenity and shelter, and looking at this case on strict commercial principles, it would be consistent with good estate management to cut down and dispose of the whole whenever a good price is to be had. By doing this two important objects are gained, viz., the money is realised and the ground can be replanted, so that the second crop will be a number of years further on than if the whole were not cut until all were at maturity. And where there is only one-half or two-thirds of a crop of trees left on the ground, the increased value of the wood will not equal the value of the money received for them if sold at the proper time and the amount realised judiciously invested. Again, suppose a fir plantation from 40 to 50 years old, worth say L.30 or L.40 per acre, will such a plantation continue to increase at a ratio equal to the cumulative interest of L.30 or L.40, and the value of a succeeding crop? In other words, is it most profitable during a period of 80 or 100 years to grow two crops of wood or one? Or take the medium,—two crops at 45 years old and one crop at 90 years; suppose the first to be worth L.50 per acre, the cumulative interest of that during 45 years would be about L.400; deduct L.40 as the cumulative interest of cost of replanting, leaves L.360 as against the price of the wood at 90 years old. Supposing it to have increased at 5 per cent, which is a high rate, the value at 90 years would be L.162, 10s., being a balance of L.197, 10s., and the value of the second crop in favour of cutting at 45 years. At 45 *versus* 75 the balance in favour of the former would be L.55, besides the value of the second crop. At 45 *versus* 60

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the balance in favour of early cutting would be L.12, 10s. per acre, and the second crop 15 years in advance. These statements are worth consideration, although contrary to ordinary practice. The general opinion is that timber ought not to be cut until it is full grown; but, as a rule, wood merchants put little value on trees being matured or ripe, their chief object is to get them of a useful size and free from disease. At present quick production and quick returns are the ruling axioms of all profitable enterprises, and there is no reason why the same rule should not be applied to the production and disposal of timber. In fact, before the growth of timber occupies the position which as a branch of rural economy it ought to do, it must be clearly shown that the profits can be realised within a reasonable period. This can only be attained by disposing of timber when of sufficient size to suit the markets. Probably the highest revenue will also be procured by the same method. There are exceptions to this proposition, as all slow-growing varieties that reach the maximum price when they are of large size must be allowed to grow to maturity.

The expenses connected with the disposal of timber depend upon the mode of sale adopted. Occasionally these expenses are very considerable, and materially reduce the value of the wood. This is not so observable in small as in large lots, although, other things being equal, the proportion is the same. To reduce these expenses to the minimum, the exposer should arrange that as much as possible of the work of cutting and transport should be done by the purchaser. In general, wood merchants can do this more cheaply and advantageously than proprietors, as they have special plant for the purpose. If done by the proprietors, it should be as much as practicable by piece-work. Good roads are an important consideration for a wood merchant; and exposers of wood are often penny wise and pound foolish with regard to roads. In general, when a lot of wood is to be sold, the roads ought to be put into good repair previous to the day of sale. The amount of traffic expected must in all cases decide as to the quality and make of a road. Good roads are seldom made for the especial transit of wood, although in many cases they add from 5 to 15 per cent. to the price of the wood,—bad roads often detract as much. In large plantations it will ultimately increase the revenue to have the main roads good and substantial.

Where water power is available for floating, driving saw-mills, or such work, every facility should be given to have it applied either by the exposer or purchaser. If by the latter, it is generally

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satisfactory to have the dams, weirs, sluices, lades, &c., put in good repair, and given over to the purchaser on the condition that they be left in the same state,—damage done by heavy floods being excepted.

On estates producing an annual timber revenue, it is important to consider how much can be profitably disposed of at one time; in the case of large lots, care must be taken that the market is not glutted or competition suppressed. Wood merchants are not proverbial for playing into each other's hands, but the reverse. Still cases of the kind have happened, and the exposer should guard against such occurrences. This can be done by arranging the lots in such quantities and disposing of it in such ways as to meet the wants of the district. For small quantities, ranging from L.10 to L.50, the mode adopted must be either tender or private bargain, as it rarely pays to call a roup even for L.50. Lots of timber worth from L.500 to L.5000, principally of one class, may be sold profitably in one lot, especially where it is necessary to manufacture the timber on the ground. It may be said that selling in such large quantities tends to suppress competition, and play into the hands of extensive timber dealers and capitalists; but by making the terms of payment easy, and holding a proper security over the wood, the small capitalist is not only encouraged, but accommodated. Instances could be given where lots sold above L.5000 have been bought and wrought most satisfactorily by individuals of small capital.

Entailed Estates.—Difficulties sometimes arise in disposing of wood in large lots on entailed estates, especially if the heirs of entail signify disapproval of the proceeding. Under these circumstances, it is not judicious to dispose of large quantities at one time, unless with the full consent of all interested parties. Lots worth from L.500 to L.1000 are sufficient to bring out the best wood merchants in the district and induce competition. For the removal of lots of this size the time is necessarily more limited; the purchaser's risk in the event of a change of proprietors is not so great, and therefore it is not so requisite that they should take instruments for their own security.

As regards competition for large lots, it is well known that extensive dealers only attend sales where the quantities are such as to be remunerative, and in general it is only such dealers who have the appliances and machinery for manufacturing wood to advantage. Every encouragement ought therefore to be given to the capitalist, as a part of whatever profits he may derive from the simplifying or reducing of labour is sure to revert to the producer in the increased

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value of the rough wood. Exceptions to this statement may be taken in favour of local traders, but such exceptions do not alter the general principle. No doubt where there is a local demand a saw-mill on a small scale, or even a pair of sawyers, may carry on a profitable trade, and be able to give large prices for the wood they manufacture. That is no criterion. The hand-spinner and the hand-loom weaver can do the same in their calling; but it is the extensive manufacturers and capitalists in all departments of industry that by their several appliances have raised the price of the raw material. Such being the ascertained fact regarding ordinary manufactures, the same naturally follows in regard to wood. The large wood-merchants are at present paying for rough wood more than double what it was when portable machinery was first introduced and capital employed in its manufacture and transport.

Mixed kinds of wood suitable for different classes of work are most profitably disposed of in small lots, provided the site is within easy distance of where the wood is to be used, and the quantity not more than sufficient for local demands. On the other hand, where the quantity is large, it should be sold in one or more large lots, even although it is not to be manufactured on the ground, as contracts for the transport of large quantities are readily entered into at greatly reduced rates, while the transport of small quantities cannot be so advantageously arranged, whether by road, sea, or rail. The cost of transport being one of the principal items to be considered in estimating the value of a lot of wood, it follows that the lower the rate of transport the higher is the price of the wood; therefore such reductions, although made directly in favour of the purchaser, are, by the increased price given for the wood, indirectly for the benefit of the seller.

How to regulate the payments of large lots, so that while accommodating the purchaser to a reasonable extent, the exposer's interest shall be secured, is a question on which much difference of opinion exists. It is doubtful how far in the interests of legitimate trade the wood merchant with insufficient capital ought to be encouraged to compete for lots that are beyond his means. The length of time that must elapse before money can be realised from wood bought in a rough state, makes it imperative that the wood merchant should have large capital or good accommodation, and a reasonable accommodation given by the exposer will invariably enhance the price. So long as such accommodation does not encourage speculation it may be given to a reasonable extent; at the same time the interests

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of the exposer must be secured. For this purpose the simplest method is to make the payments within a given period by fixed instalments—the purchaser only obtaining right to such a quantity of the wood as the exposer shall consider to be covered by the instalment paid. To counterbalance this, so as to give a fair chance to the capitalist, a rate of discount commensurate to the time at which the instalments are payable should be offered for ready money. This method is common, and although at first sight it may seem a little one-sided, it has been found to work well for all parties. The capitalists may occasionally object if the percentage allowed for ready money is considered insufficient, but there is seldom much difficulty in regard to this matter. In my experience the system has been found to work well, and it has neither been abused nor seriously objected to.

In the sale of small lots by tender or private bargain, ready money, or what is considered equivalent, payment within the month of purchase, is the most common and the most satisfactory mode of settlement.

In sales by public auction, the conditions usually declared are, that the lots are at the purchaser's risk after they are disposed of by the auctioneer. However, settlement should invariably take place before their removal. Bills for wood sales by public roup are not recommended; and where it is necessary to have them, the auctioneer should guarantee the sale. This he will readily do for a small percentage, and the exposer has neither risk nor trouble in the matter. These are the general rules to be considered before any definite mode for the disposal of timber is adopted, and they may be modified to suit local circumstances and the custom of the district.

To particularise all the ways by which timber can be profitably disposed of would extend this paper unnecessarily. In my opinion the whole may be summarised under tender, public or private; public auction; private bargain, by weight or measurement; and in a manufactured state. Each of these systems is suitable for the profitable disposal of timber under certain circumstances, but they differ widely in their application. This will be best illustrated by considering the merits of each system, and the circumstances under which each should be adopted.

I. *Tender, Public or Private*, is the most flexible and economical of the modes indicated. It may be adopted for disposing of home-grown timber or coppice wood under all circumstances, whether standing, cut, or wind-blown, in quantities varying in value from L.10

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to L.1000. It is unquestionably the mode by which large quantities of growing wood can be most profitably disposed of, whether in one or more lots, and especially when it requires to be manufactured before removal.

For lots of wind-blown or standing trees, where the whole are to be cut, the felling should be done by the purchaser. Before the sale it is only necessary to have the trees counted and classified (they are sometimes numbered, but this is not essential). As soon as the tender is accepted and the payments arranged, the wood settled for should be at the purchaser's risk. Two years ago the writer sold a lot of Scots fir and larch for upwards of L.800, and the expense of counting and classifying only amounted to 10s. for the whole. In the case of thinnings, the work requires care, so that the most thriving trees may be left to grow, and the expenses of preparing for sale are therefore rather more, as it is necessary that the trees should be numbered as well as classified. In classifying, three classes are generally adopted, viz., timbers, spars, and props. In some districts a given size for each of the classes is recognised, a plan which should be universally adopted. It often occurs that the exposer, or those acting for him, makes three classes, independent of recognised sizes. In such a case, it is best to put beside the number on the intermediate class a × or other distinctive mark. This is a simple and effective method, and by adopting it the classes are easily ascertained. Thinnings, though sold standing, should be cut off the roots at the expense of the seller, the purchaser cross-cutting and snedding.* Snedding is often done along with the cutting, but the purchaser sometimes objects that it is not rightly done. There is often good cause for this objection, as it is almost impossible to get a tree properly sned until it is turned, and this can be most easily done after the tree is cross-cut; indeed, some heavy trees can scarcely be turned until they are cross-cut. The cutting off the roots should be done by the exposer, to insure its being done carefully; but it is not necessary, as some allege, that it should be done by day's wages. On the contrary, it can be done as carefully and more economically by contract. My practice is to let all the cutting by contract to some of the workmen employed on the estate. This is generally done at from 5s. 6d. to 10s. per 100 trees, or at about 10d. per 100 cubic feet. Of course there are exceptions to this, as when the thinnings are growing amongst hardwood trees, and special care is required in the cutting. In such

* This Scotch expression corresponds to the German *schneiden*, to prune or amputate.—ED.

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cases the work is invariably done by day's wages, under supervision. Objections to this mode of selling timber and allowing it to be taken out of the woods by the purchaser are sometimes made, it being alleged that wood merchants' people are more careless with the horses in dragging than the proprietor's, and also that men cutting by contract are more careless than when cutting by the day. Such may be the experience of some who have had unscrupulous parties to deal with, but it is unfair to make a general allegation. Wood merchants and other people are usually anxious to leave a place in good condition so that they may return to it again. For this reason alone —if for no higher—it is their interest to take good care of the standing trees. However, to prevent any risk in the matter, it is best to provide in the conditions of sale that all damaged trees are to be taken by the purchaser and paid for at double or such other prohibitive price as may be agreed upon.

As regards the cutting of trees by contract, there are few practical foresters who have not done a little in their time, and their opinion of others will almost invariably be a counterpart of their own practice under similar circumstances. A writer in our Transactions (vol. vii. p. 74), states that he has "never found any practical forester or wood manager declare that it was the most satisfactory way of doing the work;" but many foresters follow this system, for the reason forcibly stated by the same writer—"the cheapness whereby sales conducted in this way can be effected." The argument with which he answers this statement is, that timber merchants generally pay a higher rate of wages for felling, &c., than proprietors do, and that the expense of such work must be made up in some way. If the writer carefully considers the whole matter, he will probably come to the conclusion that wood merchants do not pay a higher rate of wages than they can avoid, and also that it is their interest, as well as that of proprietors, to have the work done as cheaply as possible. On the other hand, it is seldom that work is cheapest or most satisfactorily done at the lowest rate of wages: the contrary is generally the case; and the reason that wood merchants pay higher wages than proprietors is that they have a better class of men—or at least men who work hard and thoroughly understand their craft.

Sales by tender, if private, are generally made known by circular; if public, by advertisement or sometimes by schedule, containing, besides the number and class of trees, a printed copy of the conditions of sale and blank form of tender. This latter is a commendable method, whether the sale be public or private, and will become

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more general. The mode of tender should be stated in the conditions, but it is usually given by offering a slump sum for each lot, or in the case of coppice woods a rate per acre. If desirable, it can be given at a rate per tree, or any number of trees, or per foot. It is always understood that neither the number nor classing is guaranteed, and the offerers are always held as having satisfied themselves on these points before offering; and no claim on the grounds of any shortcomings or inferiority can afterwards be entertained. The party whose offer is accepted is held bound to subscribe a formal agreement of sale embracing the general conditions. The cost of sales by tender seldom amounts to one per cent. of the sum realised. The only objectionable form of sale by tender is where an agreement is entered into, or an offer accepted for a given number of trees, at a fixed rate before the trees are actually marked or counted. In the case of thinnings and prop-wood this has often been done, but the results have generally been so unfavourable to the seller that the mode has seldom been tried a second time. Such forms of sale are unsound in principle, and the failures resulting therefrom are owing to the defective agreement, and not to the sale by tender.

II. *Sales by Public Auction.*—This mode is specially adapted for disposing of timber grown within easy reach of a good market, or adjacent to manufacturing towns; and also for all mixed lots of wood suitable for country purposes. In fact, firewood and wood suitable for fencing are often sold by auction at rates above market prices. However, in the preliminary arrangements a good deal of expense is incurred, as previous to the sale the wood has to be cut and lotted as near good roads as possible, and the several lots distinctly numbered. The relative value should also be ascertained, so that a reserve price may be put in if required.

In preparing the lots great care is needful to separate the trees suited for different purposes, and to arrange those adapted for the same purpose in lots to suit purchasers. The reasons are obvious, as parties who may wish one class of wood for one purpose may not want another, and would be prevented from offering; or if they did offer, it would only be by putting a small value upon the class they did not want—a value, in fact, at which they could dispose of it readily to another party. In the neighbourhood of Edinburgh sales by public auction are common yearly, or in some cases half-yearly sales being an institution on some estates. They are also generally adopted throughout Scotland for selling mixed lots. Even some of those who sell their large lots by tender, adopt this mode

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for mixed lots that are cut within or adjacent to the policies. For this class of sales, so long as the supply does not exceed the local demand, public auction is without doubt the best mode of disposing of mixed lots of home-grown timber.

The expenses connected with the preparation of wood for sale by auction are considerable; but so long as the competition is kept up, prices sufficient to pay for the extra outlay are generally obtained. Instances to the contrary have occurred, and cases are known where the purchasers have agreed not to bid against each other. This only occurs where the competition is limited, and under such circumstances sales by public auction should not be adopted. Instances are also known where the sum realised for the wood did not pay the expenses of cutting and preparing for the sale. These instances occurred in a district where only a small local trade exists, and therefore unsuitable for selling wood by auction except in very small quantities. It will thus be seen that although public auction is a desirable mode of selling timber, its success depends upon the district, local demand, and quantity to be disposed of. In my experience neither wood-merchants nor consumers are in the habit of going far to attend auction sales, except for some particular trees, or class of wood that is difficult to procure.

The conditions relative to this mode of sale have been indicated, and all lots are understood as being at the purchaser's risk immediately after being disposed of by the auctioneer. Still it is generally considered requisite to have a reliable man in attendance to watch the proprietor's interest during the time the wood is being removed. In this way many difficulties that might arise regarding roads, gates, &c., are prevented.

The cost of preparing wood for sale by auction generally ranges from 15 to 25 per cent. of the total sum realised, according to the quality and kind of wood. The expense depends upon the situation, particularly as regards the roads and access to the plantations.

III. *Sales by Private Bargain.*—This mode is more or less adopted in all woodland properties; but it is not to be recommended except under special circumstances, such as—*First*, For disposing of wood from plantations in the immediate neighbourhood or centre of a mining district, where the consumers are willing to give the full market price for whatever wood they require. *Second*, Local sawmills, boat-building yards, and other tradesmen may be supplied on the same terms, viz., market price. *Third*, Telegraph poles, pit props, or any other class of rough wood for which, at a stated depot,

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a fixed rate can be obtained for a given size and quality of wood. In any of these cases the wood should be sold by measurement,—in the case of turners' wood and firewood by weight. On delivery of the wood a note of the measurement or weight, or what is better, a regular invoice, should be forwarded to the purchaser. The strict adoption of this mode prevents difficulties, facilitates business, and is beneficial to all parties.

All classes of wood should be charged at recognised market rates; and if any change of price takes place, formal intimation of such change should be made to the purchaser before any wood is charged at the increased rate. Wood sold in this way is generally delivered at the premises of the purchaser, or put on rails at the expense of the exposer. The market price is sometimes considerably curtailed by the expense of delivery and transport. For instance, a wood-manager on a large estate lately sold a lot of heavy Scots firs at 11d. per cubic foot put on rails. He had everything done in the most economical way, and on comparing notes it was found that the actual price got for the wood in the rough state was rather below 6d. per foot; while for wood of a smaller size and inferior quality sold by tender, an average of 6½d. per foot was readily obtained in the same district under similar circumstances as to situation, distance from railway station, &c. This result is mentioned to show that although apparently high prices are got for wood when sold in this way, these are often not so in reality. Therefore, before adopting this mode, it is well to count the cost carefully. Where large quantities of firewood or other rough wood are sold by weight and to be delivered, the cartage should be by contract at a fixed rate per ton. Railway weights, when taken advantage of, should be binding on all parties. For small lots of fuel or fencing wood, it is not generally considered requisite either to weigh or measure. Fencing wood is generally sold at a rate per dozen, and parties accustomed to sell such lots can easily fix their relative value. In all strictly local transactions, delivery should be given in the plantation for the purchaser to remove at his own expense. Some parties consider private bargain the best mode for disposing of all sorts of forest produce; but the writer does not recommend it save in exceptional cases, as those indicated. The expenses connected with it are seldom less than 30 per cent., and sometimes as high as 50 per cent., on the gross receipts.

IV. *Manufacture of Wood by the Producer.*—The writer cannot report from personal experience, not having had the management of

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sale saw-mills. Still he has had considerable experience in manufacturing wood for estate and building purposes, the result of which has led him to form the opinion that it is not profitable for the producer to be the manufacturer. If it is desirable that such a mode be adopted, portable machinery must be introduced and used; and the whole of the work in connection therewith should be done by the piece, as in that way only can a profit be realised. Fixed saw-mills for manufacturing wood for sale may pay well for a few years, or so long as wood is within easy reach; but the expense of horse work soon comes to be so great that the saw-mill, instead of being a profit, entails considerable loss. Many wood-managers having adopted this method, or finding it in operation when entering their situations, utilise the mill as well as they can, without making any comparative calculation as to whether it is profitable or otherwise. This is not surprising, as it is always difficult to make radical changes and to move expensive plant and machinery. No doubt there are instances where wood has been profitably manufactured by the producer, but these cases are rare, and the successes have invariably been dependent to a great extent upon local circumstances.

A wood manager who has manufactured wood extensively for sale for upwards of twenty years, unhesitatingly states that it is the most profitable mode of disposing of home-grown timber. However, this case is exceptional, as a good road runs almost parallel with the woods, and he has command of sufficient water power. Besides these advantages, there is a special local trade, and he has never had occasion to compete much with wood-merchants in the open market. It is worthy of notice that, with all these advantages, he has been obliged to keep a stock of *foreign* wood, to accommodate and keep on his customers. This fact speaks for itself.

On the other hand, the opinion of one of the most extensive wood managers in the north of Scotland is so decided on the subject, that he sells all the wood in a rough state, and contracts with merchants to supply the manufactured wood required for estate purposes. Where the manufacture of wood is practised, the mode of sale is usually by private bargain, already noticed. It may be added, that all experience goes to prove that wood sales should be made as open and public as possible, especially by foresters or those who are acting for other parties. The expense of manufacturing timber under favourable circumstances and with good appliances generally adds about 75 per cent. to the price of the rough wood.

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Many facts drawn from experience and observation could be given in support of the foregoing statements, but the following summary will serve to indicate the writer's general conclusions :—

1. It is most profitable to dispose of wood when it is of a size and in a state to command the best price.

2. Whatever mode of sale is adopted, the wood should be sold in such quantities and at such periods as will insure good competition.

3. Where an annual income is derived from wood, the periods of sale should be yearly or half-yearly, that purchasers may make arrangements accordingly.

4. It is more profitable to dispose of wood by a clean cut than by thinning or selecting mature trees; but the amenity of the property having to be considered, often militates against this mode of procedure.

5. When timber is to be manufactured on the ground, it can be most profitably disposed of in large lots, provided they are not spread over too wide an area.

6. Detached lots should be tendered for separately.

7. When practicable the wood should be sold standing; and, except in the case of thinnings, the work of cutting, &c., in connection therewith done by the purchaser.

8. As much of the work as possible should be done by contract.

9. Good roads are a great advantage, and add considerably to the value of wood.

10. Water power, where available, should be taken advantage of, and handed over to or shared with the purchaser, especially if the wood is to be floated or manufactured before removal.

11. Sale by tender, public or private, is the mode most applicable under various circumstances for profitably disposing of home-grown timber.

12. Sale by public auction in small lots is the most profitable mode of disposing of mixed timber suitable for country purposes, or within easy reach of manufacturing centres.

13. At sales by public auction the lots should be arranged and classed to suit the purchasers.

14. Sale by private bargain, save in exceptional and special circumstances, such as those indicated, is not adapted for the profitable disposal of home-grown timber.

15. Timber can seldom be profitably manufactured for sale by the producer, except where great natural facilities exist.

16. The mode of payment should be such as to encourage the

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capitalist, and give reasonable accommodation to the purchaser, and if possible prevent speculation.

17. The conditions of sale should be distinct and simple, containing no vague expressions which can be misunderstood by either party; and however small the sale, or by whatever mode it may be effected, the whole business should be done in a legal and formal manner.

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XVI. *On the different Modes of disposing of the Produce of Woods and Plantations.* By ANDREW PEEBLES, Highclere Castle, Hampshire.

Great diversity of opinion exists amongst arboriculturists in regard to the best means of disposing of the produce of woods and plantations. This is apparent, if we observe the sales of timber advertised in the various county papers. There we see timber to be sold by the cubic foot, by the load, by the lineal yard, by the number of sleepers and pit-props, by the tree or hundred trees, by the lot, by the ton, by the acre, &c. In one district the timber is cut and arranged in convenient lots adjacent to good roads, while in the adjoining county the whole of the produce is sold standing. There are public sales, private sales, and sales by tender, all more or less practised by experienced foresters in different localities. If we inquire into the cause of this great diversity of procedure, we find it dependent on local circumstances; and yet how often is it attributed to apathy, or inexperience on the part of the forester. Many of our practical men are accused of having no fixed principles in regard to this branch of forestry, simply because they find it expedient to deviate from the old beaten track, and adopt various modes of selling the produce of the plantations under their charge. I give a *resumé* of my own experience of the different modes of selling home-grown timber and underwood, and may mention that I have seen a public sale of pit-props realise less money than if they had been sold privately, simply because the purchasers were not connected with any collieries, and consequently left a large margin for intermediate profits. In the same district, I have seen oak for which the forester was offered 1s. 2d. per foot privately, sold by auction for 1s. 9d. per foot. Again, if the plantations are within easy distance of a powder factory, where a fixed price prevails for charwood, that circumstance will be taken advantage of when there is any powder wood for sale. It would serve no good purpose to sell small alder, birch, limetree, &c., otherwise than by private sale, although, on the same estate, the most profitable way to dispose of oak, ash, and other hard woods may be by public auction. I have myself sold alder in the Lothians at L.1 per ton; in Lancashire at 1s. per foot, and in Hampshire at L.22 per acre. Here we have three distinct modes of disposing of the same sort of produce, and each equally appropriate for the locality where the crop was grown. It

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is clear that no fixed principle is applicable to all cases, and therefore the intelligent forester wisely adapts his *modus operandi* to the various circumstances of the neighbourhood in which he is situated.

Private Sales are best adapted for disposing of any produce which, owing to local circumstance, has a fixed market value in the district. A large rake manufactory regulates the price of rake-ware, a powder-mill determines the price of charwood, and collieries control the price of pit-props, sleepers, or any timber required for mining purposes. When local causes such as these determine the price of any plantation produce, no auction sales will realise more money than can be obtained privately; but if the competition is indifferent, the timber may sell considerably under its market value. Private sales are also adapted for small estates, where the quantity of timber sold is too limited to defray the expenses of sales by auction. If the quantity of timber to be disposed of at one cutting is under L.50, it is not advisable to incur the expense of advertising, printing, and auctioneer's fee; but if the quantity to be sold exceeds L.60, the extra money realised by public competition will more than compensate for all additional expenses. My first experience of private sales was acquired in the mining districts of the north of England. There the proprietor's work-people invariably cut the timber, and arrange it in convenient lots, where free access can be had for its removal. In arranging the lots for sale, the various sorts of timber are kept separate from each other—ash from oak, oak from beech, large timber from timber suitable for sleepers, sleepers from pit-props, pit-props from piles and rails, and piles and rails from firewood. Firewood is sold by the lot, piles and rails by the score, pit-props by the lineal yard, sleepers by the pair, poles and small thinnings by the tree or hundred trees, and large timber by the foot cube. It is considered of importance to arrange the lots neatly and systematically, and to pile one tree above another in such a manner that only the best of the timber will be exposed to the purchaser's view. This is effected by placing the blemished trees in the centre of the lots, and covering them with timber of a superior quality. The intention, obviously, is to induce the purchaser to pay a price beyond the real value of the timber, and, consequently, the practice is fraudulent and deceptive. It is much better to complete the lots with timber of the same quality, and instead of piling one tree on another, have them spread out so that all can be seen and measured with facility. This avoids misunderstanding between the purchaser and vendor, and in almost every case the timber will realise more

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money than if valuable trees are used to decorate trees of inferior quality. It is often asserted that the good timber aids the disposal of the bad, but this is a fallacy I need hardly refute. Every practical forester is aware that timber will realise more money when arranged according to size and quality, than if clean grown trees are mixed with rough blemished timber. Having arranged the lots adjacent to good roads, the next thing to be done is to have them numbered and measured. In regard to measuring timber, I may remark that the system generally adopted is often fallacious. If a tree tapers gradually it is considered sufficient to girth it in the centre, but the true contents cannot be ascertained with less than three girths. In order to measure correctly with a centre girth, the tree ought to be cut in two where the small end is half the circumference of the butt end. This, however, entails extra labour, and depreciates the value of the timber, and consequently the trees are invariably kept their full length. A forester who measures with one girth will often increase the contents of his trees by allowing the purchaser eight or ten feet off the small end. The more a tree tapers beyond half the circumference of the butt, the more will the vendor loose by measuring with a centre girth. One girth is invariably in favour of the buyer, who *naturally* adheres as much as possible to that system of measuring. If he pretends not to understand any other system, the best plan is to measure the timber in two or three lengths, which is the most correct way. The other day I measured a larch tree which tapered gradually, with a centre girth, and at 20 feet long the tree contained 1½ foot more than when measured to its full length of 30 feet. I measured the same tree with three girths, and the contents were increased 4 feet. I then measured it in two lengths of 15 feet each, and this gave me 1 foot more than with three girths, and 5 feet more than with one girth. These hints are sufficient to show the necessity of measuring carefully when selling timber at so much per foot.

In selling timber privately it is difficult to meet with a purchaser who will give full value for the whole of the lots. He will regulate his price by the local demand for the sort of timber offered for sale. In one district a certain description of produce may be comparatively worthless, while in another it is the most profitable crop that can be grown. If there is no demand for any certain class of timber, it is a wise provision to make inquiries in regard to a profitable market previous to cutting the crop. When this is not attended to, the vendor must necessarily sell at a sacrifice to a purchaser who pro-

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bably knows not how to dispose of the produce he is buying. He may have a good market for pit-props, or railway sleepers, and no demand for hard-wood; or he may be able to dispose freely of all sorts of hard-woods, and yet have no market for railway sleepers or pit-props. It matters not whether the produce is hard-wood, fir, pit-props, rake-ware, or hop-poles, if the purchaser has not a ready market he will either decline to buy, or will do so at a price which will allow a large margin for contingencies. This is one of the greatest obstacles in disposing of timber by private sale. But another objection often urged against private sales is the difficulty of inducing purchasers to give full value for any of the lots. This is owing to the want of competition, and may be provided against, in a great measure, by offering the timber to several purchasers, and accepting the highest offer. That this, however, has not always the desired effect is evident from the following facts:—I once had a quantity of mixed hard-wood for sale, which I arranged in convenient lots, and offered to Mr B. at a price varying according to the quality and description of the timber. He would not purchase unless I reduced the upset price twenty per cent. This I would not consent to do, so the matter ended without effecting a sale. A few days afterwards I offered it to Mr C., but this time the reduction claimed had increased to thirty per cent. I afterwards advertised the lot to be sold by auction, and realised five per cent. more than the price originally fixed. It subsequently transpired that Mr B. had arranged with Mr C. to offer less than he had done, on the understanding that they should share alike in the purchase. These facts show the necessity for discretion in treating with timber merchants, but must not be understood to imply that the system of taking offers from several purchasers serves no good purpose. When a forester has a quantity of mixed timber to sell, he will often realise more money by receiving offers, than by confining himself to one purchaser.

Sales by Tender.—It may seem at first sight that the same object is gained by offering the timber to several purchasers, as by receiving tenders. In practice, however, the two systems differ materially. Sales by tender are generally conducted in the following manner:—The vendor sends circulars containing particulars of the number of trees to be sold, accompanied by the conditions of sale, to as wide a circle of timber merchants as possible. The circular requests them to send in their offers by a certain date, and to tender for the whole, whether it consists of one class of timber, or a mixed lot of various

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sorts. If the lot contains only one class of timber, the purchaser will probably be able to give a fair price for the whole; but if several sorts are sold together, he may have to offer for timber of little value to him. A better plan is this:—The timber is arranged and classified as for private sales, and catalogues prepared, containing the number of lots and conditions of sale. These are sent to the timber merchants, who offer for each lot separately, or only for such lots as they really require. This they do by marking the sum they are prepared to give opposite the different lots in the catalogue. The catalogues are returned under seal by a certain date, and the highest offers are accepted for the lots separately, without regard to the aggregate of the whole. Thus a purchaser whose offer is highest for oak may be lowest for beech, and one whose offer is highest for beech may be lowest for larch, and so on through all the lots. This system has many advantages over private sales, or the plan generally adopted of selling timber by sealed tender. Theoretically considered, the same object may be attained by accepting offers from several purchasers for each lot separately, and selling in the same manner as if the offers were sent in under seal. Practically, however, the result will be unsatisfactory; and this is accounted for by each purchaser being under the impression that there is no competition, and, consequently, will offer the lowest price which he thinks is likely to be accepted.

Auction Sales are best adapted for all estates where the quantity of timber or other produce to be disposed of is sufficiently large to defray the necessary expenses. It matters not whether the timber is sold standing, or prepared for sale by the proprietor's workpeople—the result, so far as selling the timber is concerned, will be the same. I may remark, however, that I once attended an auction sale of felled timber, which realised considerably less than the timber might have been sold for privately. The number of purchasers did not exceed eight or nine, and before the sale began they arranged which lot each would offer for, and consequently avoided competition. The same thing also occurred at Highclere with a sale of growing timber, which I conducted there. After dinner the whole of the purchasers left the table, and were observed in the stableyard in earnest conversation. I perfectly understood what the result would be, and arranged with the auctioneer accordingly. The first two lots were bought in at L.15 under my valuation, and in each case the auctioneer gave his clerk a fictitious name. This so completely disconcerted the stableyard arrangements, that the purchasers

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began to offer for each other's lots, and we had an excellent sale. At the close of the sale the first and second lots were again put up, and sold for L.13 more than was previously offered.

My first experience of auction sales was acquired at Arniston, near Edinburgh. There the work was performed by the proprietor's workpeople, and all the timber, except oak, was cut and arranged in convenient lots during winter. The oak was cut in spring, as soon as it could be stripped of its bark, and the sale generally took place soon after stripping was completed. In arranging the lots for sale we were particular to separate the varieties of timber, and to classify each according to its quality. It was not considered sufficient to keep oak separate from ash, and ash from beech; but we kept small trees separate from large ones, and rough timber of little value from what was clean grown and valuable. This was considered essential to enable parties attending the sale to purchase the class of timber they required, without being compelled to include timber which might be comparatively worthless to them. A country carpenter, who required a lot of small ash for agricultural implement handles, might have no use for ash of large dimensions; a wheel-wright, who required oak, might have no use for beech; and a cabinet-maker, who was ready to buy birch, sycamore, or wild-cherry, might not feel disposed to speculate in larch. It is scarcely necessary to describe the manner of lotting the timber, numbering the lots, conducting the sale, &c. These things are well understood by every forester; and neither need I advert to advertising, as it is customary that all auction sales should have at least two or three insertions in the best county newspapers. In addition, the forester should forward catalogues to as many timber merchants as possible. I have always found that a liberal distribution of catalogues secured a larger attendance of buyers than any other system of advertising. When this is neglected, the vendor will seldom realise the full value of the timber he has for sale.

Many people maintain that auction sales never realise more money than sales by tender, and occasionally less. In support of this view, they argue that if purchasers send in sealed tenders of the full amount they can afford to give for each lot of timber, no competition will induce them to go beyond these figures. If, on the contrary, competition is languid, they are not unlikely to purchase the lots under what they consider their fair market value, and what they would naturally have offered for them by tender. From these apparently logical deductions, we might infer that sales by tender

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had many advantages over auction sales; but, in practice, I have invariably found the reverse to be the case. Let us suppose that A. B. and C. attend an auction. They have each contracts on hand for which the timber advertised for sale is admirably adapted. Previous to the day of sale, they go round the lots, and measure and value them very carefully. We will further suppose that lot 3 consists of thirty fine large oaks, which A. and B. respectively require for a special purpose. When the lot is put in, these gentlemen refer to their sale-books, and find it valued at L.80. The "bidding" is general until it reaches L.75, after which it is continued exclusively by A. and B. Eventually the hammer falls to B.'s "bidding" at L.15 over his valuation, and A. remarks, "You have paid very dear for that lot, sir." The next lot again goes beyond its value, and this time B. continues the "bidding," to retaliate on A. for making him pay so dear for the previous lot. In this manner several lots are disposed of, which C. required to complete a contract in hand, and he is now prepared to exceed his own valuation, rather than lose any of the remaining lots which are suited for his purpose. In this way the competition becomes lively, and a purchaser, disappointed in several of the first lots, usually makes an effort to secure some of the remaining lots. This is no imaginary picture, but what often occurs at sales, and it is this competition and rivalry amongst purchasers which constitutes one of the principal advantages of auction sales over private sales, or sales by tender.

Underwood Sales.—In the southern counties of England, underwood constitutes a very important crop. It consists principally of oak, Spanish chestnut, ash, birch, and hazel, and is sold periodically at 11, 12, and 13 years of age respectively. In fertile plantations, comparatively sheltered, the underwood is as large at 11 years old as it is in the upland districts at 13 years, and hence the age of the underwood varies accordingly. It is worthy of remark, however, that the underwood which has been grown in the upland plantations is worth considerably more than what has been grown in sheltered localities. The value of the crop, however, is controlled in a great measure by the condition of the plantation in regard to timber trees. If the plantation is overcrowded with trees, the underwood will be comparatively worthless; if it is fairly thinned, the underwood may be worth L.4 per acre; and if thinned severely, it may realise from L.8 to 10 per acre at 11 years old. In the upland districts, where it is considered superior for making crates, sheep-cages, hurdles, and hurdle-stakes, it sells readily at L.11 per acre at 13 years' growth.

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In calculating the value of this crop, the periodical thinnings, as well as the continual increase in value of the permanent crop, must be added to the sum received for underwood. I find by taking a period of 60 years, and adding the whole receipts, the two crops combined will realise about L.2 per acre for the land after deducting expenses. In fertile districts the receipts are more, but seldom less, even in an exposed situation and thin gravelly soil resting on chalk.

Underwood is divided into convenient lots, and invariably sold growing, either by auction or private sale. If the shoots are distributed regularly over the ground, the crop is sold by the acre; but if the underwood is patchy, with large vacant spaces, it is generally sold at so much per lot. The reason for selling by the lot in such cases is to avoid the inconvenience of measuring and deducting the vacant spaces, which it would be unfair to include when computing the area. The rule in this neighbourhood is to have the lots accurately measured, and the contents entered in the catalogues previous to the day of sale. This must be done with great care, as it is difficult to get straight lines where they are required in a full crop of underwood. In some districts it is sold at so much per acre, without stating the quantity; and when this is the case, the ground is measured after the crop is cleared. The advantages of this system are, that the ground can be measured with less trouble and more correctly; and the disadvantages, that the purchaser cannot ascertain the quantity of underwood he is buying, and the auctioneer has no data for demanding the usual deposit. On the whole, it is best to measure the underwood previous to sale, and when this is carefully done, errors seldom occur.

Another description of woodland prevalent in the south of England is termed "Gullies." Large tracts of low-lying marsh lands are planted with alder, willow, poplar, and ash, and when judiciously managed are highly remunerative. A good "gully" will pay a rent of upwards of L.2 per acre after deducting expenses, and that too for land almost worthless for agricultural purposes. Occasionally wet plantations are thinned severely and converted into "gullies;" but gullies, par excellence, have no timber in them to exclude the light and injure the valuable undergrowth. The produce is divided into lots, and sold in the same manner as coppice underwood. If the gully is free from timber and stagnant water, the usual price is from L.21 to L.22 per acre for nine years' growth. As the underwood is sold growing, and must be cut and cleared by the purchaser, the expenses to be deducted are merely nominal. It is

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often maintained that the proprietor's own workpeople ought to cut and convert the whole of the underwood before it is sold. This would be something like converting timber for sale, and would have to be done very judiciously to be remunerative. It is well known that proprietors who convert their own timber seldom realise so much money, after deducting expenses, as those who sell it unconverted. The reasons assigned are many and various, but I think the principal cause is that the forester has neither time nor experience to compete with those who devote their whole energies to this branch of business. A saw-mill is a great acquisition, and very desirable on every estate; but it ought only to be used to convert timber for estate purposes, or for the benefit of tenants, who are often allowed rough timber for their repairs. Theoretically considered, a proprietor who converts his own timber and sells it afterwards, ought to secure all the intermediate profits; but in practice, his profits vanish, and the whole thing works unsatisfactorily. The same thing would occur were proprietors to attempt to convert their underwood. Hurdle-stakes would be made into fagots, hurdle-rods into "withs," rake-ware into hoops, and hop-poles into sheep-cages. Those who buy our underwood are hard-working men, whose lives of experience enable them to convert expeditiously, applying each piece of wood to the purpose for which it is best adapted. If a staff of inexperienced workmen were to convert a piece of underwood, it would probably be of less value after they had finished than before they began. The more valuable the underwood, the less chance there would be of its being converted judiciously, and for these reasons I recommend underwood to be sold growing in the manner described. Every description of underwood is sold as soon after the fall of the leaf as circumstances will permit. The following "conditions of sale" are printed and distributed with the catalogues:—

Reservations and Conditions of Sale.

1. The highest bidder to be the purchaser; and if any dispute arise, the lot in dispute shall be put up again and resold.

2. No person shall advance less at each bidding than 2s. 6d. per statute acre.

3. The purchasers to take their respective lots with all faults, and at the close of the sale pay to the auctioneer a deposit of 20 per cent. upon and in part payment of the purchase-money; the remainder of the purchase-money to be paid on the 29th September 1874, or

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security must be given to the satisfaction of the vendor, for such payment before any part of the underwood will be allowed to be cut or carried away.

4. The underwood shall be cut in a workman-like manner, the stems not to be cut lower than is usual for future growth, nor to be split or broken off. All samplers or timber-like trees which are marked, shall be carefully preserved; and if any be cut or injured, or any other damage be committed by the purchaser of the lot, his workmen, or customers, such purchaser shall pay treble in value for each sampler or timber-like tree cut or injured, and shall also pay full compensation for any damage done.

5. The whole of the underwood shall be cut before the 25th day of March next; and the underwood cut to be cleared off by the 10th day of April next. Any wood which may remain on the ground after the day above named shall be forfeited to the vendor.

6. The purchaser is to make use only of the usual roads, and to make good all damage done or committed in cutting or taking the wood away; and no dogs to be taken into the woods either by the purchasers or their workmen; and where the boundaries are *required*, the purchaser must make the hedge in a workman-like manner.

7. If the purchaser neglect or fail to comply with these conditions, the deposit-money shall be forfeited to the vendor, who shall be at liberty to resell by public or private sale the lot or lots bought by such purchaser; and any deficiency, and all expenses which may be caused by such resale, shall be made good by the purchaser in default or his sureties.

Sales of Growing Timber.—I will now consider the system of selling growing timber by auction as practised on many estates in the south of England. Growing timber is generally sold in the months of January and February; but if the sale consists exclusively of oak, it may be deferred until March or even April. Ash, firs, and all sorts of timber except oak, are sold as early in the winter as possible, to afford the purchasers sufficient time to cut their trees before the sap begins to circulate in spring. With oak the case is different, as oak bark, though much cheaper now than formerly, is still a consideration with timber merchants, who leave their oak until the middle of April, when stripping begins. In regard to stripping, I may mention that it is done more economically and efficiently in the south than in many parts of Scotland. The whole process is briefly this:—At the proper time to begin (which is ascertained by a perceptible enlargement of the oak buds), the woodmen

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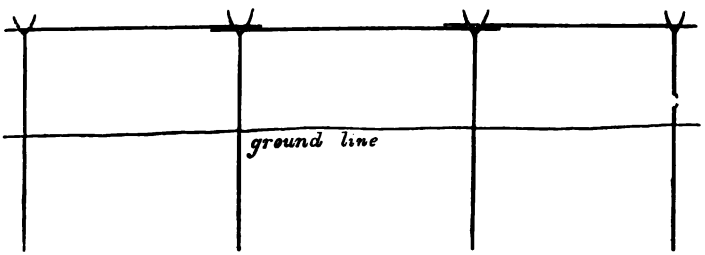
commence operations by testing the state of each tree with the stripping iron. If the bark moves easily, the tree is cut; but if not, it is left, and earlier trees selected first. This is a much better way than felling every tree indiscriminately, whether it will strip freely or not, leaving a party of women and boys to hammer the bark off as best they can. When a tree is felled, the trunk and head are stripped as expeditiously as possible, and no lopping of branches is performed except such as cannot be conveniently reached by the strippers. The whole of the work is performed by men, who engage to cut the timber, strip and dry the bark, and tie it in bundles ready to load, at 28s. per ton. Instead of erecting bark ranges, capable of supporting a thick layer of bark, they merely select a number of straight pieces of stripped oak which are supported in forked stakes, about 2 feet high. These straight pieces of oak are arranged in one continuous horizontal line, and the bark is erected on either side of them in the form of the letter A. This secures a continuons and effectual current of air from end to end, which thoroughly dries the bark in eight or ten days if the weather is favourable. In wet weather the bark must be reversed occasionally; but even if the weather is unfavourable, it is never damaged so much as when deposited in a thick layer on the top of a bark-range. Being placed on end, the water passes quickly off it without washing out any of the tannin, and when the weather clears up, it is soon dry and ready to send to the tanyard. The following represents the bark-range referred to, which is the only form of range used in this neighbourhood:—



When the timber to be sold consists of various sorts of hard-wood, including oak, it is best to sell the whole together as early in the winter as possible. Occasionally it is considered expedient to sell the mixed hard-woods in November, and the oaks early in the following spring. I cannot see, however, that much advantage is

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gained by this system, as the same object may be attained by selling the whole together, and allowing the purchaser to leave the oak lots until spring. Our practice here is to thin the woods where the underwood has been previously sold; and we always begin to prepare for timber sales as soon as sufficient underwood has been cleared to enable us to proceed with marking the trees. This is done by myself and two assistants in the following manner:—I first mark the trees with a racing-iron, and one assistant follows with a bill-hook with which he shaves off part of the bark, in readiness for the second assistant, who numbers the trees with white paint. When there are more than one lot in the same plantation, we distinguish them by means of capital letters. For instance, we begin by marking the letter A on several of the first trees in the first lot, and then proceed to number from 1 to 50, or any other number fixed upon for lot 1. Towards the end of the lot a few more trees are marked with the letter A, to indicate where A finishes and B begins. Lot 2 is numbered on the opposite side of the trees, and several of the first and last trees of the lot are marked B—the numbers again running from 1 to any number fixed upon. Lot 3 is marked C on the same side of the trees as lot 1, and lot 4 is marked D on the same side of the tree as lot 2, and so on with all the lots to the end of the plantation. Sometimes the timber varies considerably in size and quality, and when such is the case, it is necessary to have one or more lots of small inferior timber in each place. As these lots run through all the other lots of good timber, the distinguishing letter ought to be marked on every tree, so as to avoid confusion when the trees are being cut. We distinguish the lots in the catalogues in the following manner:—

Lot.	Great Penwood.	Marked.	Numbered.
1.	Fifty fine oaks, . . .	A,	1 to 50
2.	Sixty navy oaks, . . .	B,	1 „ 60
3.	Ninety small oaks, . . .	C,	1 „ 90

Another system of marking often adopted in the south is to carry on consecutive numbers to the end of each plantation. Thus, lot 1 would be numbered 1 to 50; lot 2, numbered on the opposite side of the tree, would begin with 51 and end with 110, and so on through all the lots. The system of distinguishing the lots by figures instead of letters is not understood in the south, and is seldom adopted. It is, however, a convenient method of marking trees, especially if there are many lots in one plantation. It is

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done thus—Lot 1 is numbered $\frac{1}{1}$, $\frac{2}{1}$, $\frac{3}{1}$, and so on up to $\frac{60}{1}$. Lot 2 is numbered $\frac{1}{2}$, $\frac{2}{2}$, $\frac{3}{2}$, and so on up to $\frac{60}{2}$; and lot 3 is numbered $\frac{1}{3}$, $\frac{2}{3}$, $\frac{3}{3}$, and so on to the end of the third lot. In each case the upper figure represents the number of trees, and the lower figure the number of the lot in the catalogue.

Having marked all the trees by one of the preceding systems, the next thing is to advertise the sale, and get the catalogue printed and widely circulated. Previous to the day of sale I measure and value the whole of the lots, inserting particulars in a sale book kept for the purpose. The sale book is divided into columns, with the following headings:—1st, Date of sale; 2d, No. of lot; 3d, Name of plantation; 4th, No. of trees; 5th, Description of timber; 6th, No. of loads; 7th, Average measure per tree; 8th, Rate per load; 9th, Forester's valuation; 10th, Price realised at sale; 11th, Remarks; and, 12th, Purchasers' name and address. The first nine of these columns are filled in previous to the day of sale. Of course the three last can only be filled in after the timber is sold. A book of this description is absolutely necessary in order to see that the timber sells at its full value, and it is also an excellent reference book in after years.

To those unaccustomed to measure growing timber, it will appear a laborious undertaking to measure and value two or three thousand growing trees. It is not so difficult, however, as many people imagine, and an expert hand will easily measure from 800 to 1000 trees in a day. We keep a staff of six or eight labourers to show the lots and assist in measuring the timber, and a few days before the sale the whole of them are employed with different parties. Each timber merchant requires two assistants; one carries a long pole marked in feet, and the other a leather strap which indicates the side of the square. In going to work, the man with the pole declares the height of the tree in feet; the man with the strap the side of the square in inches; and the timber merchant refers to his sliding rule for the contents. The measurer has to allow an inch and sometimes more, for the taper of the tree from where the girth is taken, to the centre of the portion he is measuring. Of course this is measuring with a centre girth, but an experienced measurer never goes higher than half the circumference of the butt, and adds the number of feet he considers the tree contains above that point. All these things are puzzling to a beginner, but it is astonishing how accurate an old practitioner's work is. Some people contend that it is impossible to give an approximation of the contents of

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growing timber by means of a pole and strap. They argue that an experienced judgment and practised eye are more to be depended upon than a deceptive pole and strap. If those using the pole and strap were to discard the eye and judgment, there might be some force in this reasoning, but as they do not, the whole argument falls to the ground. I speak from experience when I assert that there is seldom a difference of 5 per cent. in the measurements of the various purchasers, and when the lots are afterwards tested most of them are actually within 5 per cent. of the truth. In my opinion no amount of experience will qualify a forester to calculate the contents of growing timber as accurately when trusting to the eye alone as when assisted by a pole and strap. I admit that there is a great waste of time in the most expeditious way of measuring growing timber, but if the trees are sold growing they must be valued in some way, and no better plan seems hitherto to have been adopted than that practised in the south. If a sufficient staff of men are employed on the estate, I would strongly recommend the timber to be cut and prepared for sale by the proprietor's own workpeople. This obviates the necessity for measuring growing timber, which can be done more expeditiously and correctly after the trees are felled. On many large estates, however, this is not practicable, as the quantity of timber annually sold is out of proportion to the number of woodmen employed. When such is the case, the usual way of getting over the difficulty is to sell the timber growing, under such conditions and reservations as will protect the vendor against wilful damage, and ensure the timber being cut and cleared away within a specified time. The following are our conditions of sale for disposing of growing timber :—

Conditions of Sale.

1. The timber to be sold by the lot, the highest bidder to be the purchaser; and if any dispute arise between two or more bidders, the lot in dispute to be put up again and resold.

2. No less a sum than 10s. shall be advanced at each bidding under L.20, and 20s. above that sum at each bidding, nor shall any bidding be retracted.

3. The purchaser of each lot shall, immediately after the sale, sign a contract, and pay into the hands of the auctioneer a deposit of 20 per cent. on the amount of the purchase money, giving sufficient and approved security within ten days from the day of sale, for the payment of a moiety of the remainder on the 29th day of

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September next, and the other moiety on the 26th day of December following; and if the amount, or respective amounts, shall not be paid on the said days, or either of them, or if the purchaser or his surety shall fail, and any timber shall remain on the estate, the vendor shall be at liberty to prevent the removal thereof without discharging the purchaser or his surety from liability on such security till the amount be paid.

4. That the timber shall be carried away at the purchaser's expense on or before the 1st day of October next, and that he and the persons to be employed by him shall not grub nor take away any of the stools or roots, nor do any wilful damage to the crops or lands where the timber is now standing, nor to the timber which may remain on the premises, nor dig any saw-pit upon any part of the said land and premises.

5. That the purchaser shall have liberty for his workmen, horses, and carriages to pass and repass by all usual and proper ways for removing the timber, from the time of his giving the aforesaid security to the said 1st day of October next, but no part thereof shall be felled or removed before such security be given.

6. The lots to be fagotted within one month from the felling of each tree, otherwise to be forfeited to the vendor. No dogs to be taken into the woods, either by the purchasers or their workmen.

Lastly, If the purchaser or purchasers shall refuse or neglect to comply with the foregoing conditions, the deposit money shall be forfeited, and the vendor shall be at liberty to resell the lot or lots bought by such purchaser, either by public or private sale, and if any deficiency shall happen by such resale, the same shall be made good by the purchaser or defaulter.

These are our conditions, and before closing this paper I will state a few of the disadvantages of selling growing timber. If the purchaser resides at a distance from the place of sale, he is put to considerable inconvenience in getting woodmen to cut the timber. He has also to arrange with some one to cart the bark, and must make several visits to the plantations while his men are stripping oak and drying it. All this leads to expense and loss of time, and, in my opinion, the whole thing could be more satisfactorily done by the forester on the estate. If a sufficient number of woodmen are not permanently employed on the estate, he could engage men temporarily to cut the oak and cure the bark by piece-work, and on the same terms as agreed upon by the wood merchants. The forester on the spot

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would be able to superintend the whole of the woodmen, and see that no damage was carelessly or wilfully committed. When woodmen are employed by timber merchants, they require to be as diligently supervised by the forester as if he employed them himself, and he labours under the disadvantage of not having them so thoroughly under control as if he were their paymaster. A staff of negligent or inefficient workmen may soon do much damage to the permanent crop, and when they are not engaged by the forester, it has a tendency to make them more careless than they otherwise would be. I have heard of careless woodmen cutting down every tree they injured, in order to obliterate all traces of the damage they had committed. If damaged trees are dealt with in this summary manner, it would clearly be to the timber merchant's advantage to employ as careless a staff of workmen as he could find. I have also heard of unprincipled purchasers cutting large numbers of trees which were not marked, and sometimes actually agreeing with their workmen to pay so much per tree for all *extras* cut. When *extras* are being cut, the clearing of the timber goes on as the work proceeds. This is done with the view of preventing the forester detecting the fraud by counting the number of felled trees, which would be in excess of the number stated in the catalogues. Another way of detecting the fraud would be to count the number of stools, but the stolen trees are always cut very low, and the stools covered with leaves and rubbish. These precautions may deceive an inexperienced forester, but a practical man can tell by the state of the permanent crop if more trees than necessary have been cut in the usual course of thinning. I must say, however, that I have never had to deal with cases of this sort, and I believe very few timber merchants would connive at anything so dishonourable. The timber merchants that I have come in contact with are highly respectable gentlemen, incapable of taking a single tree that was not justly their own. But apart from the question of honesty, I advocate the timber being cut and arranged in lots previous to sale, as alike advantageous to buyer and seller, and more satisfactory in every way than the present system of selling growing timber.

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XVII. *The different Ages at which various Timber Trees may be most profitably felled in different soils and situations.* By Lewis Bayne, Forester, Kinmel Park, North Wales.

Timber trees are planted with the view of profits being derived, either directly from the sale of the timber, or indirectly by giving shelter to stock and crops, and increasing the value of an estate by adding to its amenity. But in this short paper I shall confine my remarks to trees yielding profit from the sale of their timber, as trees grown for shelter or ornament, or partly for both, are generally allowed to grow beyond maturity before being filled.

At the outset it may be observed, that much depends on management whether the planting of trees will turn out a profitable or a losing investment; and whatever may be the kind of trees, or the soil in which they grow, their general management in judicious pruning and thinning on the one hand, or total or partial neglect on the other, will have much to do with the age at which they can be most profitably cut down. When trees neglected in their youth are drawn up, and branchless except within a few feet of the top, in consequence of over-crowding and want of judicious thinning, they become prematurely ripe before reaching half the normal age and size. In such cases, the most profitable system would be to fell the whole at once and replant the land, as after trees pass a certain stage thinning is of little avail, and a loss and waste of time results from any attempt to improve them by changing the management. But even with careful treatment and thinning from the first, the results are different as regards the age at which trees should be felled, the quantity and quality of the timber, and the revenue to be derived by the proprietor therefrom.

Thus, it occasionally happens that trees in the same plantation, and in the same soil, do not arrive at maturity simultaneously—one tree becoming mature, it may be, when eighty years planted, while another close by may not reach the same stage before one hundred years; but such is the exception and not the rule, as in well managed plantations trees in the same kind of soil generally attain maturity about the same time, although they may vary much in size.

It is stated by some that Scots fir, larch, and spruce can be most profitably cut at from twenty to thirty years of age, when growing in a locality where they can be disposed of for mining purposes;

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but I have not found this to be the case in my experience in the management of plantations within fifteen miles of large coal mines. In such a locality, when the price of prop-wood is high, it will almost invariably be found that proportionally high prices will be obtained for larger timber. While, if the plantations be far from a market, or a railway station or seaport, the crop at that age would not be worth the planting, cutting, and removing, and would therefore be a dead loss to the grower of from twenty to thirty years' rent of the land. Further, it would not pay to cut down trees of the above description for fencing and estate purposes, because these can easily be supplied from the thinnings of well managed plantations.

It has already been remarked that, as a rule, timber trees should be allowed to grow to large dimensions before being cut; but the situation in which they grow often necessitates a different course. For instance, in glens and mountainous districts, and in places inaccessible to horses, the most profitable management would be to cut them down before they arrive at a size too large to be removed in entire lengths by manual labour. At that early stage fir trees would be valuable for prop-wood, fencing, and other estate purposes; ash for handle-wood, and birch or alder for charcoal or bobbin-wood, &c.; whereas, if allowed to grow to a large size, they would have to be cross-cut in lengths to admit of their removal by men, and this would, in the first place, make the timber useless for many purposes for which it might otherwise have been valuable; and secondly, the expense of removal by manual labour might equal, or even exceed, the value of the timber itself. When Scots fir, larch, or spruce have been planted as nurses for hard-wood trees, they should be thinned out as soon as they begin to encroach on the trees intended for the main crop, as this is necessary for the welfare of the plantation, irrespective of the value of the thinnings. But when such trees are planted as the future crop, on suitable ground, it will almost always be found most profitable to allow them to attain timber size.

The larch being of fast growth, and useful for various purposes at an early age, can be cut down profitably much sooner than the Scots fir.

Oak is extensively used for ship and boat building purposes, furniture, agricultural implements, &c., and is longer than any of our forest trees in arriving at maturity. It can never be cut down so profitably when small, as when well matured and having plenty of heart-wood. When young and with little heart-wood, and a large

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proportion of sapwood, the timber is of comparatively little value per cubic foot, so that it can seldom be cut down profitably, especially if thriving on soil suitable to its growth, until it reaches one hundred years old. Of course, when grown as copse-wood, it ought to be cut young; but even under the most favourable circumstances in Scotland copse-wood is less profitable to the proprietor than a crop of timber, and larch can be grown more profitably in most situations. The oak is of slow growth when young, but on suitable ground it increases rapidly after about thirty years. It sometimes happens that oak, planted in good soil and in a sheltered position, attains a large size, but has little matured heart-wood at sixty or seventy years old, and in such a case it would be better to allow it to remain till fully matured, when the value of the timber per cubic foot would be materially enhanced.

The ash, although capable of growing to large dimensions, can be cut down more profitably in its young state than other hard-wood trees. When clean grown, and from thirty to forty years of age, it is in great demand for handle-wood, and for agricultural implements; but in a rich loam, with dry subsoil, it would be more profitable to allow it to grow to double that age.

The alder is generally in good demand at all stages of its growth, after arriving at sizes suitable for the clogger, and for turnery, or charcoal, and is seldom grown to very large dimensions. Thriving best in damp soil, it can be profitably cut down at forty years' growth, making way for a second crop, which springs up rapidly from the stools.

The beech is of little value in its young state, and is seldom cut till well grown.

Birch, like the alder, can be cut down profitably at about forty years old, being then in good demand for cloggers, charring, and turnery purposes; and, when of large size and good quality, it is extensively used for furniture.

Horse chestnut is seldom planted for profit, but is valuable as an ornamental park tree. When grown on good soil and in a sheltered situation, however, it can be profitably cut down when it attains large dimensions.

Spanish chestnut is of most value when of large size, and is in many cases used for the same purposes as oak. It is most profitably cut down when about one hundred years old.

Elms (Scotch and English), are of little value until they have arrived at timber size, and should therefore never be cut as a crop

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until they are from eighty to one hundred years old. When on good soil, the English elm will, when matured, be of large dimensions. The Scotch elm seldom attains so large a size as the English elm, but its timber is of more value when matured, and forms heart-wood sooner.

The lime tree, like the horse chestnut, is seldom planted for profit; but when of large size is in great demand for brake blocks for railway purposes, &c. It is, however, of little value before it is sixty years old.

Poplars can generally be most profitably sold when about fifty years old. Being very fast growers, they arrive at timber size sooner than most of our timber trees, and the wood is then much used for brake blocks, boarding, &c. When of small dimensions, the wood of this tree is of little value.

Sycamore and Norway maple, although in demand for turnery purposes when of small size, can seldom be cut down to full profit, until they have arrived at maturity, and attained large dimensions, when high prices are obtained for them for printing blocks, &c., and larger timber becomes proportionally more valuable. When the sycamore is planted in a good soil, well drained and sheltered, it may be profitably cut down at about one hundred years old.

The willow, like the poplar, is a fast grower on suitable soil, and can be cut down profitably about sixty years old, and for its timber there is a good demand.

Gean tree or wild cherry, holly, and laburnum are more grown for ornament than for profit, though, in some instances, good prices can be obtained for their timber. The two latter seldom attain a large size, and may be felled any time when in demand, after attaining a size suitable for turnery. In consequence of its hardness and susceptibility to receive a fine polish, the wood of these trees is much sought after.

The walnut, when matured, is much esteemed for furniture, &c.; but is of little value in its young state, and is generally planted for its fruit or as an ornamental tree.

The annexed table shows the different ages at which, in accordance with my experience, timber trees growing in different soils and situations can be most profitably felled.

[TABLE

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TABLE—*Showing the different Ages at which Timber Trees can be profitably Felled.*

NAMES.	Clay Soil or Heavy Loam.		Strong Loam and Gravel Subsoil.		Light Loam resting on Gravelly Subsoil.	Light Loam resting on Sandy Clay Subsoil.		Strong Sandy Loam and dry bottom.	Light Loam and moist Subsoil.	Poor thin Sandy Soil and dry bottom.		Dry Sandy Loam and dry bottom.	Rich Alluvial Loam and dampish Subsoil.	Dampish Clay or Loam along the margin of rivers, &c.	Stony Loam and dampish Subsoil.	Gravelly Loam or Slate on Granite formation.	Gravelly Loam on Limestone formation.	Loam resting on Gravel and Slate formation on sloping ground.	REMARKS.
	Sheltered.	Exposed.	Moderately sheltered.	Moderately sheltered.			Sheltered.	Sheltered.		Exposed.	Exposed.	Sheltered.	Moderately sheltered.	Moderately sheltered.	Moderately sheltered.		Exposed.	Sheltered.	
Ash, . . .	60	90	70	80	80	70	...	70	80	60	70	60	60	60	Loses its toughness when old.
Alder, . .	50	50	...	...	...	40	...	...	50	40	40	...	...	...	Succeeds well in damp soils.
Beech, . .	70	80	90	80	100	80	120	100	70	70	80	90	80	90	
Birch, . .	60	60	50	60	50	60	70	60	40	40	40	50	50	60	
Chestnut, Horse	80	...	80	90	90	100	...	...	100	90	80	...	...	...	Apt to get damaged by wind.
,, Spanish	100	80	100	120	100	100	...	70	120	80	100	...	...	100	
Elm, English,	70	80	100	90	110	80	...	90	70	...	70	...	...	90	Grows to a large size in good soils.
,, Scotch,	80	80	100	100	120	90	80	100	80	...	80	...	...	100	
Lime, . .	90	80	...	80	80	100	...	...	120	90	100	...	...	80	
Oak, . . .	120	100	80	100	110	90	...	80	120	...	100	...	...	80	Requires good soil to grow well.
Pine, Scots, .	70	80	80	70	70	60	80	80	60	...	60	90	50	70	
,, Spruce,	60	50	40	50	40	60	...	...	60	50	60	40	40	50	
,, Silver,	70	60	50	60	50	60	...	...	60	50	60	50	50	60	
,, Larch,	50	70	80	60	70	50	40	50	50	...	40	70	40	90	
Poplars, . .	60	60	60	50	50	60	...	40	70	50	60	40	40	50	Fast growers in moist soil.
Sycamore, .	80	100	110	80	100	80	90	120	80	...	...	100	110	110	
Willow, . .	60	60	45	50	50	60	...	40	70	50	50	...	...	50	Thrives best in damp soil.

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XVIII. *On the Natural Production or Self-Sowing of the Common Silver Fir* (Picea pectinata). By WILLIAM GILCHRIST, Forester, Cluny Castle.

In a plantation on the estate of S——, in the county of Aberdeen, my attention was arrested by detached plants and scattered groups of young silver firs. The person accompanying me, who had been connected with the plantation for upwards of forty years, assured me that there had been no plants of any description planted there since he knew the plantation. On closer examination I found seedlings ranging from two to fifteen years old, and came to the conclusion, that here was an ascertained fact which ought to be communicated to the Scottish Arboricultural Society.

The part of the plantation in which the seedling silver firs are found is said to have been formed about the end of last century, but the date cannot now be accurately ascertained. At present it appears to be from eighty to eighty-five years old. The larch forms rather more than half of the crop, the remainder being Scots fir and spruce, with a few silver firs, beech, lime, plane, and birch. No regular mode of thinning appears to have been adopted, my companion informing me that during his time nothing had been done beyond supplying the tenants with wood for fencing and fuel, except when a hurricane blew down a lot, which had to be cleared out and sold. The trees are therefore tall and much drawn, except some near the outside of the plantation, which have had more space. The larches are of fine quality (when sound), tall, clean in the boll, and the bark free from blister, but many are "royed" at the root. Six years ago a large quantity of the smallest larches were cut for fencing, and almost all were "royed" at the root; a number of the larger spars were cut during the present year, and it was ascertained that fully four-fifths were more or less affected with the disease. The spruces are also inclined to be "royed," and show signs of being at maturity. The Scots firs are quite sound, but, like the spruce, are evidently mature; their timber is good but rough, the branches being strong and coarse; the bark is also, with slight exceptions, very rough, and most of them have lost their leading tops. Some of the silver firs still have main leaders, but others have lost them, and gone off into numerous lateral shoots. The original silver firs are models of beauty and symmetry, some, notwithstanding their close confinement, being clothed with branches almost to the ground. These branches are small, and do not give the trees the rough ap-

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pearance they generally have when so closely furnished with branches. The timber is quite sound, and of good quality. They also appear to be in perfect health, and will probably increase in value for some years to come; long after the spruce, larch, and Scots fir are decayed or cut down, the silver firs may remain with their progeny at all ages springing up around them. The cubic contents of the silver firs are considerably greater than that of any of the other trees. The measurements of the largest trees will demonstrate this:—(See p. 182).

These measurements present a striking contrast in favour of the silver fir, and it is even greater in reality, as the latter are not nearly so much tapered as the others. This is not owing to their having been grown under more favourable circumstances, as in one instance two silver firs, which are bracketed in the table, are growing at 24 feet apart, and most of the others have been so closely mixed up with the other varieties, that the larch and Scots fir were growing under the drip of the silvers, and even amongst their branches. These particulars are mentioned to show that the situation appears to be well adapted for the growth of the silver fir.

The soil is a light brown loam, containing a large percentage of granitic and vegetable matter, with large granite boulders cropping out on the surface. The subsoil is gravelly clay, resting upon granitic gravel, much used for blinding metal on roads, but which on exposure turns rather clayey and soft, especially after frost.

Where the silver firs are growing, the exposure is north-east by north. The ground is steep, rising at a gradient of about 1 in $2\frac{1}{2}$. The altitude, as per Ordnance Survey, ranges from 580 to 750 feet above sea-level. The general configuration of the ground is conical, steeper towards the north and east. The extreme altitude of the hill is 974 feet; the average height of the surrounding cultivated land being 740 feet from south-east to north-west by west, and 450 feet from north-west to south-east by east.

Seedling silver firs are found growing close to all the large trees, but are more numerous in some places than in others, and particularly in spaces that have been partially opened up by hurricanes. In these open spaces the seedlings are chiefly from eight to twelve years old, a few being about fifteen years. A number are from two to five years old. In fact, they are to be found at all ages from two to fifteen, but from eight to twelve and from two to five are most numerously represented. The theory that I would advance is, that the presence of these seedlings is due to the hurricanes of October 1860 and February 1868. On both these occasions many trees were

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TABLE—*Showing Measurement of Largest Trees.*

	Silver Fir.							Spruce.							Scots Fir.							Larch.						
	Girth from Surface at						Height.	Girth from Surface at						Height.	Girth from Surface at						Height.	Girth from Surface at						Height.
	1 Foot.		3 Feet.		6 Feet.			1 Foot.		3 Feet.		6 Feet.			1 Foot.		3 Feet.		6 Feet.			1 Foot.		3 Feet.		6 Feet.		
	Ft.	In.	Ft.	In.	Ft.	In.	Feet.	Ft.	In.	Ft.	In.	Ft.	In.	Feet.	Ft.	In.	Ft.	In.	Ft.	In.	Feet.	Ft.	In.	Ft.	In.	Ft.	In.	Feet.
No 1.	8	2	6	10	6	6	90	5	9	4	9	4	5	78	5	11	5	4	5	0	67	5	9	4	8	4	5	75
„ 2.	7	9	6	5	6	2	85	5	7	4	8	4	6	70	5	6	4	9	4	6	70	5	5	4	5	4	0	73
„ 3.	7	7	6	4	6	0	95	5	4	4	7	4	4	65	5	5	4	10	4	8	55	5	2	4	6	4	0	75
„ 4.	7	7	6	8	6	4	87	5	3	4	6	4	4	70	5	5	4	9	4	5	50	4	11	4	1	3	8	68
„ 5.	7	5	6	4	5	10	83	5	3	4	3	4	0	67	5	5	4	11	4	7	60	4	9	4	0	3	9	75
„ 6.	9	6	8	6	4 6	9 0	95	5	2	4	5	4	0	75	5	3	4	11	4	5	53	4	8	4	1	3	9	70
„ 7.	7	3	6	2	5	10	70	5	0	4	4	3	11	73	4	9	4	2	3	11	55	4	8	3	10	3	7	74
„ 8.	6	7	5	7	5	5	64	5	0	4	1	3	10	65	4	8	4	2	3	11	50	4	8	3	10	3	4	75
„ 9.	5	10	5	0	4	10	45	4	10	3	8	3	6	68	4	8	4	1	3	9	57	4	9	4	3	3	10	70
„ 10.	6	9	5	10	5	6	92	4	8	4	1	3	11	75	4	6	4	1	4	0	54	4	7	3	10	3	7	73
„ 11.	6	2	5	5	5	2	87	4	4	3	8	3	6	60	4	5	4	3	4	0	55	4	5	4	0	3	9	65
„ 12.	5	9	4	10	4	7	85	4	4	3	6	3	4	65	4	3	3	11	3	8	63	4	4	3	9	3	4	65

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uprooted; and after the trees were cut and cleared off, the roots were taken out for fuel. Portions of the surface were thus opened up, and the seeds germinated and grew readily.

Seedlings being most numerous between the ages of eight and twelve, and between two and five, would seem to confirm this theory; but apart from this, seedlings of all ages are most numerous in a partially opened space near the outside of the plantation, where roots for fuel have been periodically grubbed out. It has also been observed that larch and Scots fir seeds germinate most readily in plantations where roots have been holed, and after wind-blown trees have been cleared off. All this is only theory, and I will not pursue it further, but the fact remains that seedlings of the common silver fir are growing in K—— plantation. That fact having been ascertained, the circumstances most favourable for their further development or reproduction can be observed and noted.

Seedlings are not to be found beyond a radius of 60 yards from the old trees, and this extreme distance is invariably up the hill. Throughout the plantation within this radius of the old trees there are several silver firs from thirty-five to forty years old, about 38 feet high, and from 2 to 2½ feet in circumference at 3 feet from the ground; these may also be natural reproductions. In some parts of the plantation there are a few self-sown plants of the common spruce, as also a few larches, but the almost total absence of Scots fir seedlings is curious. Indigenous birch, rowan, raspberry, and holly grow freely from seed, and broom in some of the more open spaces, along with *Vaccinium Myrtillus* and *Calluna vulgaris*. The natural herbage in the plantation where the silver firs are growing consists principally of the following:—

Flowering plants.—*Cardamine hirsuta, Digitalis purpurea,* Galium saxatile,* Goodyera repens, Hypericum pulchrum, Luzula pilosa, Oxalis Acetosella, Ranunculus acris* and *repens, Rumex Acetosa* and *Acetosella, Stellaria Holostea, Tormentilla officinalis, Trientalis europæa, Scabiosa succisa, Viola canina, Veronica Chamædrys* and *officinalis;* as also the beautiful and rare *Linnæa borealis.*

Grasses.—*Agrostis vulgaris* and *canina,* Aira flexuosa,* Anthoxanthum odoratum, Festuca ovina, Holcus mollis* and *lanatus.*

Ferns.—*Pteris aquilina, Blechnum boreale, Asplenium Filix-fœmina, Aspidium Filix-mas* and *dilatata, Polypodium Dryopteris.*

Mosses.—*Dicranum scoparium; Hypnum loreum, purum, proliferum, splendens,* triquetrum,* and *undulatum; Polytrichum commune.*

* Those marked * are most plentiful.

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XIX. *Note on a Wood damaged by Gases from Calcining of Ironstone.* By ANDREW SLATER, Forester, Loftus, Yorkshire.

The wood is within five hundred yards of the calcining hearths, and is twenty acres in extent; it consists of oak, ash, elm, plane, black Italian poplar, horse chestnut, Spanish chestnut, holly, lime, alder, common spruce, Weymouth pine, larch, Scotch fir, and silver fir. The calcining hearths were in operation in the spring of 1870, and as soon as the oak and holly were in foliage the leaves became white round the edges, and soon after white spots appeared all over the leaf. The other hardwood trees were little affected that year, but all the pine tribe were much damaged the first season, and although part of the foliage remained green, wood was not made that season nor since, and last autumn (1872) they were all dead except the Scotch fir, which retained a few green leaves till it was felled this spring. The elm, ash, plane, alder, and lime were not much damaged the first two years, but since then they have made no wood. The Spanish chestnut had the same appearance the first season as the oak, and the horse chestnut was sheltered by other trees from the effects of the fumes, so that I cannot say what the effects would have been upon them had they been exposed.

The black Italian poplar is the only tree that is not affected in any way; it is as healthy as can be, and made good shoots this season (1873), although exposed more than the other kinds, being at least 40 feet higher than the other trees.

There are two acres of wood, ten years old, consisting chiefly of black Italian poplar, with larch and Scotch fir as nurses. The poplars are all in robust health, without the least sign of blemish on their leaves, but the nurses are nearly all dead or dying. The wood was very healthy previous to 1870, but now it has the appearance of being burned with fire, and that part of the estate looks very desolate.

The twenty acres were sold and a portion cut down and barked, part of which had the bark as adherent to the wood as at midwinter; it is still standing.

We cut and barked four acres of oak adjoining the above plantation, and the bark came off well; it is the same distance from the calcining floors as the other, but is screened from them by a rise in the ground, and I believe that if screens were erected round the

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hearths the gas could be prevented from spreading to the injury of any crops around them, whether of grain or wood. There is a large percentage of sulphur in the ironstone, and while the stone is undergoing the process of calcining, sulphurous acid gas is generated, which is very destructive to vegetation; but being more than twice as heavy as common air, it does not rise much higher than the top of the heaps, and might be confined within proper screens. The gas has an offensive smell, which is never felt far from the works, unless when carried along by the wind.

NOTE.—The effects of different gases on trees and vegetation generally is an important subject, and demands the attention of proprietors and foresters at the present time, in order that more information may be obtained. Some valuable papers have been published of late years treating of the subject. Reference may be made to the following:—Gladstone "On the Growth of Plants in various Gases," "Philosophical Magazine," 4th series, vol. ii. p. 215; Turner and Christison "On the Effects of Poisonous Gases on Vegetation," "Edinburgh Medical and Surgical Journal," vol. xxviii. p. 356; Livingston "On the Effects of Narcotic and Irritant Gases on Plants," "Transactions of the Edinburgh Botanical Society," vol. vi. p. 380.—ED.

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XX. *On a new Transplanting Machine.* By JAMES KAY, Forester, Bute Estate, Rothesay. (Plates I. and II.)

Having a number of trees to transplant in spring (1873), and there being nothing more suitable for the purpose than a common janker used for transporting logs, I carefully considered the construction of those machines that have been in use for some time, such as M'Glashan's and M'Kay's (referred to in Brown's "Forester"), as well as the old-fashioned janker; it appeared to me that none of them possessed the simplicity and power necessary for carefully lifting, removing, and transplanting trees. The old-fashioned janker undoubtedly possesses sufficient power, but the tree is put to a severe test at the outset by being torn from the ground by physical force, and the roots and branches rudely dragged along the ground, and the earth jostled from the upturned root at every movement. Certainly a more barbarous way of pulling a tree out of the ground could not be devised. The construction and mode of lifting the tree by M'Kay's machine is certainly more satisfactory than with the janker. Still the means of getting the wooden bars placed under the root are somewhat imperfect, and cannot bear up the weight of the tree so effectually as if placed immediately under the root—the planks being placed along the outer edge of the ball, thereby straining the roots. The raising of the tree is also performed in a slow and cumbrous manner, being effected by common hand screws, and the chain made to pass round the planks on which the tree rests.

In regard to M'Glashan's machine, however effective it may be in raising shrubs or moderate-sized plants, it seems to me to be unsuited for removing trees of large size; for though it may be possible to lift a large plant, it is evident that if part of the "ball" should be detached, the plant would fall to the ground, not having sufficient support between the spades.

Having considered all these matters, I set about contriving how to obviate the difficulties. It occurred to me that a common hay-compressing machine possessed the elements of what was wanted. I may state that this is simply a square frame, with a movable bottom, which is compressed against the hay by chains wound round two strong iron axles by means of two strong ratchets and levers—one ratchet and lever being fixed on each axle. Still, though the levers and chains possessed the power wanted to raise any given weight, the difficulty was, how a solid platform could to be got underneath the tree without running the risk of tilting it over. It ap-

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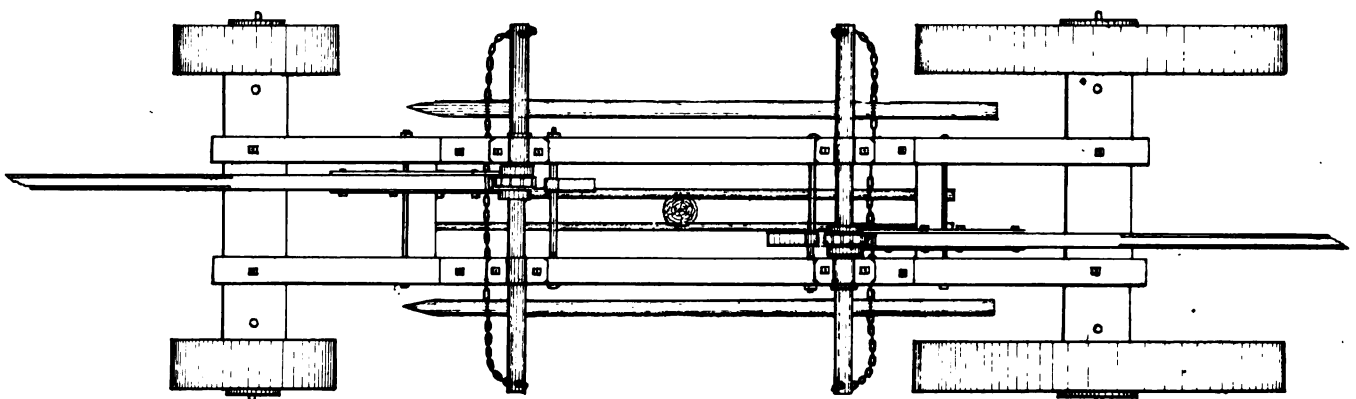
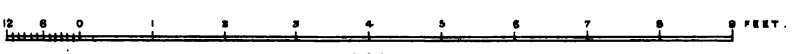
TRANSPLANTING MACHINE.



GROUND PLAN.



SCALE.

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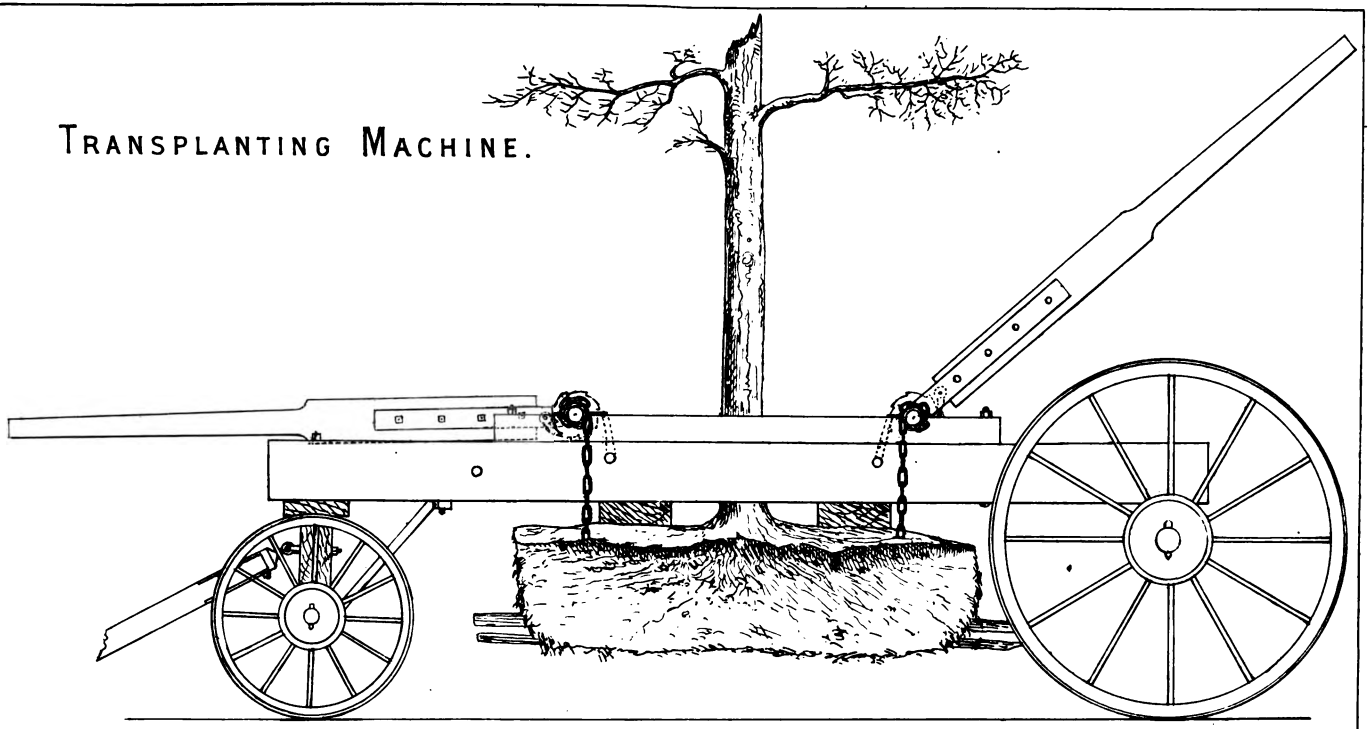
TRANSPLANTING MACHINE.



SIDE ELEVATION.

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peared to me that an effectual way of overcoming this difficulty was to have strong iron bars driven under the "ball," and to have the chains for raising the tree made with large rings at the same distance apart as the bars are from each other, and placed over the ends of the bars, the ends of the chain being wound round the axles, as in the case of the hay machine. Difficulties being so far overcome, the next thing was to have a suitable frame placed on wheels for transporting the trees to their new site. Nicety being useless, and not having time to construct all the necessary appliances, I got a pair of common broad waggon-wheels and axle, with the axle and wheels of a buggy used for transporting timber, and with these we performed satisfactory work. I will now give the details of the machine used.

The machine (see Plates I. and II.) is simply a frame formed of two strong beams placed on two axles with broad wheels. The beams are 13 feet long, 10 inches broad, by 4 inches thick; and, in order that the frame may be solid and strong when in use, and at the same time easily disconnected when placed in position for the removal of a tree, the side-beams are bolted to two cross planks, which lie immediately above the axles, the frame being kept solid and at the required distance apart in the middle by the blocks of wood placed between the beams, and in immediate contact with the jamb-bolts, which keep the machine knit together when in use. A bar of beechwood, 7 feet long and 4 inches square, is placed on the top of each of the beams, a part being hollowed out for the axles to turn in; and to keep the axles from canting over in lifting or removing a tree, they are kept in their place by iron covers bolted down to the beech bar referred to. The axles are 5 feet long and $2\frac{1}{2}$ inches in diameter, and are placed about 4 feet 9 inches apart, a strong ratchet and lever being fixed on each of the axles, and a keeper placed under each of the ratches. To facilitate the turning of the machine, the front wheels are made to turn half round under the frame by means of a locker-bolt, which passes down through the end of the frame and the axle of the fore wheels. For the portability of the machine, shafts are attached to the front of the frame, either double or single, as necessity requires. (See Plates.)

In proceeding to lift a tree, a trench is dug round at a distance, proportioned to its size, and of such a depth as to be completely under the roots. In order to lighten the "ball" the *extremities of the roots* are cleaned of superfluous soil with a common fork or grape. Before placing the machine in position, a sloping trench is made on opposite sides of the tree, so that the tree may be easily drawn on the level ground. After having the trench cleared out, and the

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roots well undermined, the iron bars are driven under the "ball." In driving the bars they must be held so as to come out parallel to each other, and on the same level on the opposite side of the "ball," and at the distance apart the large rings in the chain are from each other, so that the chain may be easily placed over the ends of the bars. Next, one end of the frame is disconnected from the connecting bar and axle on which it rests, and the machine run into the trench till the tree stands nearly in the centre of the frame. The connecting bar is again bolted and placed on the axle as before. The winding axle and lever, which have been removed to admit the tree, are also placed in position, and the chains fixed to the hooks at the end of the axles. All being now ready for lifting the tree, the levers are raised and lowered alternately, which causes the ratchets and axles on which the chains are wound to advance one tooth at a time. This is continued till the root is clear of the ground. When raising the tree, if it is found to be lower at one end of the machine than the other, raise the lower side a tooth or two while the opposite lever remains stationary. In order to keep the tree from canting over, two pieces of plank are placed between the root and the bottom edge of the frame—one on each side of the tree. These, and four ropes which are fastened about 15 feet up, and attached to the four corners of the machine, are an effectual means of keeping the tree in position during its removal.

The machine may be drawn out of the trench in various ways, according to circumstances; by men, by block and tackle, or by yoking horses, and taking it to the new site at once. When coming to a part of the road with considerable incline, in order to prevent the possibility of an accident, should the machine get "under-way," the horses should be unyoked and the machine drawn cautiously by men only; and to counteract the jolting of the machine when being drawn along a rough road, four pieces of vulcanised india-rubber should be placed between the axles and frame. The outer edge of the wheels should also be covered with several plies of matting or old sacks, or should the rough part of the road be of limited extent, the line of wheels may be covered with straw.

After the tree is drawn to the new site, and the pit ready for its reception, the machine is run into the centre of the pit, the trench being kept sufficiently wide and deep to admit of a quantity of fresh soil being placed under and around the roots. The machine being brought to the proper position, the levers are pulled down, and the keepers thrown out of gear, and a tooth allowed to escape each time till the ball rests on the ground.

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If the tree should lean to one side, have that side raised and soil placed under the root and well firmed up (so that it may not subside afterwards, a point of particular importance), till the tree stands in a vertical position. The next process is to have the frame disconnected as before and run clear of the tree. The iron bars are next pulled from under the roots by means of a horse and tail-chain. All the apparatus being now clear, the soil is filled in and the work completed.

We transplanted thirty oaks, several of them upwards of 30 feet high, and from 5 to 7 inches in diameter, besides a number of large yews and other shrubs; and, although the most of them were carried upwards of half a mile, we have not had a single failure—in fact, any person that did not know that the oaks were newly planted would never detect it from their appearance.

It may be stated that the trees were in no way *prepared* previous to transplanting, and the operations were carried on in all suitable weather from the end of February till the end of April. In fact, one large lime was in full leaf before being transplanted. The oaks are fine healthy trees, clean in the bark, and had they not been turned to account in the above way, would have been thinned out and probably made into stobs; but by transporting them as described, we have filled up the lines of the old vistas, and produced an effect in a few weeks which would have taken thirty years to accomplish by planting small saplings.

NOTE.—A number of trees were moored in the usual way with strand wire, to prevent the possibility of them being "wind-waved;" but the balls and roots being so solid and perfect, all such appliances proved superfluous.

The chains for raising the tree are formed of $\frac{5}{8}$ inch iron, 11 feet 3 inches long, with six rings in each, each ring being $4\frac{1}{2}$ inches in diameter. Lengthening hook-chains, 18 inches long, are kept in reserve should the chains prove too short for any particular specimen. In practice I found six rings were unnecessary, four rings and bars in the middle of the chain immediately under the root being sufficient. When six bars were used the outer ones tended to compress the edges of the root. The bars are formed of round iron, about 8 feet long. The outside bars are 2 inches in diameter, and the two centre bars $1\frac{1}{2}$ inch in diameter. Any measurements not given here may be obtained from the plans. The cost of the appliances, irrespective of wheels and axles, was L.16.

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XXI. *On the Altitude and Appearanee of the* Wellingtonia gigantea. By ROBERT HUTCHISON of Carlowrie, F.R.S.E., &c. (Plate III.)

Travellers from the Sierra Nevada, and other high altitudes of California, have told us, and enthusiastic writers have pictured in words of glowing interest, and enriched with varied anecdote, delineations of this mighty giant of the woods in its own native habitats. But much as we may value such descriptions, and interesting as they undoubtedly are in themselves, they but convey to the mind's eye of the arborist in this country an imperfect vision and idea of what a personal inspection with the eye of sense alone, of the form, appearance, and proportions of the actual tree itself, could thoroughly and conclusively realise. To what height and dimensions the Wellingtonia may ultimately attain in Great Britain, where it has now been fairly acclimatised, it is of course impossible to foretell; the rapidity of annual growth with which it has inaugurated its career in all sorts of situations, augurs well for its attaining, in no distant decade of years, to majestic proportions, equal at least to the dimensions of any of our well-known and established timber trees of the coniferous family, if not (as is more probable) superior to all of them in this respect.

In the meantime, forecasting what the appearance of the landscape of our native hill sides may be in future generations, from the numerous acquisitions of rare beauty of foliage, hue, and form, which have been made of recent years to our arboricultural flora, and indulging in the fancy that these newer coniferæ may attain, in this the land of their adoption, their usual dimensions in their native homes, the accompanying interesting illustration (Plate III.) will do more to convey to the members of this Society a vivid picture of how most of our tallest monuments and noblest edifices will appear relatively to the dimensions of a full-grown Wellingtonia, and how they will be dwarfed by its towering proportions.

This illustration of a most interesting subject I have been able to present to the members of this Society by the kindness of my friend, John Ord M'Kenzie, Esq. of Dolphinton, in whose possession is the original oil painting from which it has been taken.

The picture is understood to have been painted many years ago, for and under the directions of the late Colonel James Fergusson, H.E.I.C.S., a brother of Sir Adam Fergusson, and a great friend (as

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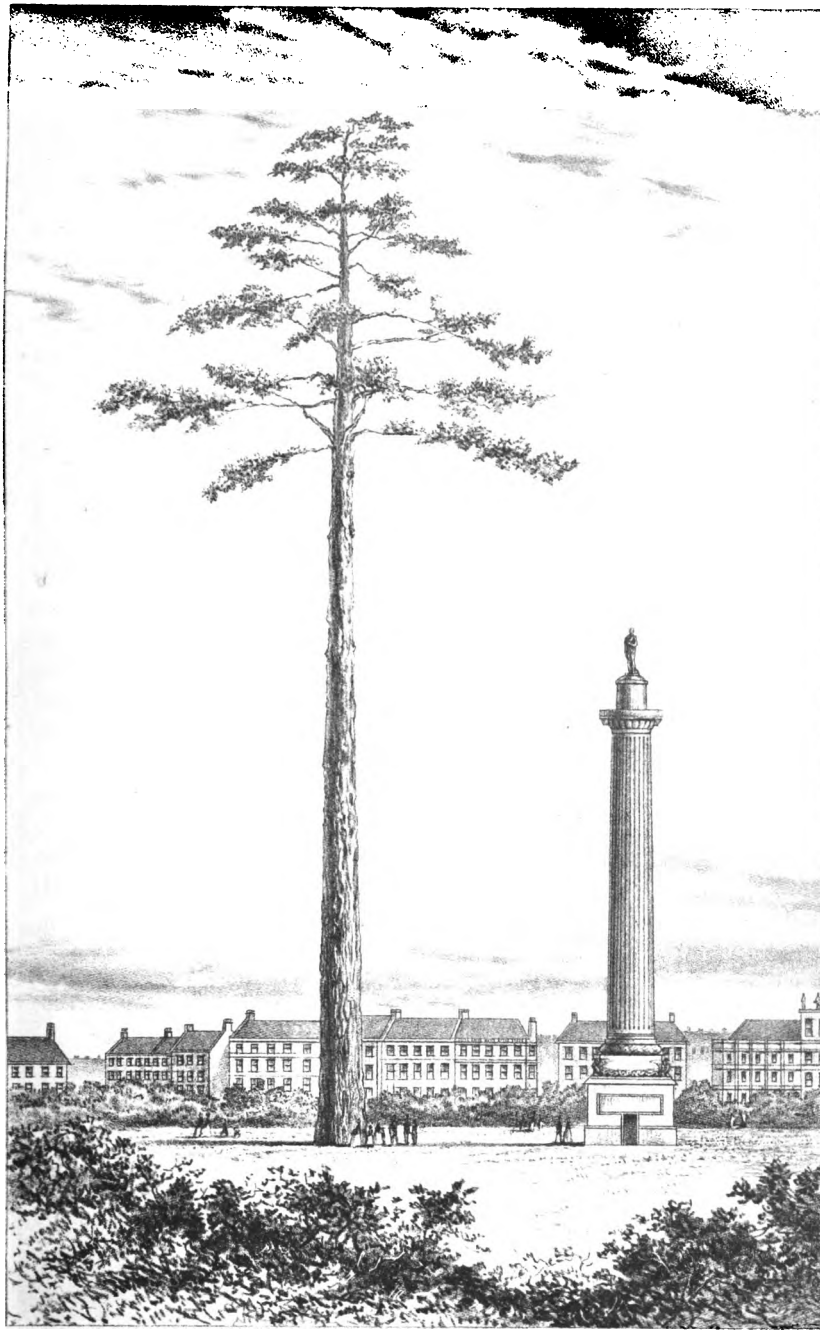

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Sir Adam also was) of Sir Walter Scott, and from whose intercourse, probably, his love of trees was derived, or, at all events, fostered. The picture is drawn on a scale with Lord Melville's Column in St Andrew Square, Edinburgh (150 feet in height.)

The picture accurately represents one of the *giant firs*, seen and measured by the celebrated travellers Lewis and Clarke, in their journey across the American continent. It was measured "with great care," we are told by Humboldt in his "Aspects of Nature," and was found to girth round the stem, "at 6¼ feet from the ground, 42 feet; its stem was 300 feet in height, and totally destitute of branches for the first 192 feet." This specimen, it will thus be seen, is by no means one of the largest of these mammoth trees, many others of those in the Mariposa, Frezno, and Calaveros groves in California being both loftier and more gigantic in circumference. For example, Mr Hutchings, in his "Scenes of Wonder in California," records the girths of no fewer than 132 of these trees, being about one-half the number of the entire grove. Looking over these measurements as given by Mr Hutchings, we find that three of the Wellingtonias exceeded 100 feet in circumference, two of them were between 90 and 100 feet, and the others varied from about 30 feet to 90 feet in girth. Many of the trees in the Mariposa grove had attained 250 feet in height; several even 300 feet; while one fallen giant, with bark gone, and its sides long since charred by fire, measured over 100 feet in circumference, and had probably attained not less than 350 feet in height. The largest of all these famous trees, however, measured in its fallen grandeur and decay, 33 feet in diameter across the butt of the stump; and as it was destitute of bark, there is little doubt that in full vigour it had girthed 120 feet in circumference, or 40 feet diameter. "Only about 150 feet of the trunk remained entire, yet the cavity where it fell is still a large hollow beyond the portion burned off; and upon pacing it, measuring from the root 120 paces, and estimating the branches, this tree must have been 400 feet high. We believe it to be the largest tree yet discovered."*

Such are a few facts regarding the altitude and dimensions of the *Wellingtonia gigantea* in its native habitats. The sites in which it appears to thrive most luxuriantly, and to attain its largest dimensions, are in sheltered valleys or gorges in the Nevada range, where the soil is deepest and subsoil moist. This quite accords

* Hutchings' "Scenes of Wonder in California." London: Chapman and Hall, 1865, p. 148.

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with what we have ascertained regarding the progress of the tree in this country. Although it will thrive in almost any soil and exposure, and will withstand severe frosts like that of 1860–61 with little and only temporary damage, yet the progress made by specimens placed in favourable circumstances as to soil, subsoil, and shelter, are most apparent. In deep loamy soil, with a subsoil tending to stiff clay, unlike many of the coniferous family, the Wellingtonia thrives best; and in any soil, if only the subsoil be damp and retentive of moisture, it will succeed admirably even in an exposed situation in Scotland. The spring winds of March and April singe and brown its foliage occasionally, and the warm sunshine during the day and chilly frosty nights of May retard and blight its development of young shoots; but all these impediments it overcomes, and plants of 20 to 30 feet in height, which in many places in April and May in any ordinary year present a very brown and withered aspect, will be found by the month of July quite vigorous and healthy in appearance, and to have entirely shaken off their sickly aspect of the spring time.

We are perhaps too apt, in considering the merits of such an acquisition as the Wellingtonia, as regards ultimate utility, to be carried away by our admiration of its handsome pyramidal form, hardiness, and beautiful foliage and habit, and to overlook its prospective value as a *timber-producing tree.* As yet few individual specimens have been cut down in this country, and these only from accidental circumstances, and hence there have been few opportunities hitherto of judging of its likelihood of becoming a valuable timber tree. If, however, we judge so far by appearances, and compare the characteristics of the Wellingtonia in habit and growth with our ideal of what a first-rate timber tree should be, we shall find that it possesses these points in singular eminence. We have hardihood, large development of trunk and stem, rapidity of growth, straightness of habit, smallness of branch shoots starting from the stem, all combined; and, it may be added, in so far as experience has hitherto found from a few examples which have been tried from home-grown trees, apparent durability of timber. The wood is light, tough, rather coarse in the grain, but very easily wrought, and not unlike the wood of the poplar, or saugh, or white cedar. In its older and more matured stages of growth, the value and texture of the wood will be found to be much improved, and to present a closer and finer grain.

The soil and climate of Ireland seem to be peculiarly well adapted for the Wellingtonia, and many instances might be recorded of very

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handsome and thriving specimens occurring in various districts. One in particular is perhaps deserving of special notice here, as being probably at the present time the tallest specimen in the United Kingdom; we refer to the tree at Cecil, county Tyrone, which, although only planted fourteen years ago, is already about 45 feet in height, and growing luxuriantly.

In looking at the illustration, one cannot fail to be struck by the bare and scant appearance of branches forming the head of the tree, a peculiarity very unlike the habit of the young specimens of the Wellingtonia as known to us in this country; but the representation, as the writer has learned from an eye-witness of the *big trees*, is quite accurate. The peculiarity of the trees in their native habitats is not their umbrageous heads or wide sweep of branches, but their immense massive trunks. A traveller in California in 1873 gives the writer the following account of his visit to the giants:—"On my way to the Losamite valley I took the Mariposa 'trail,' and there with two friends, one the travelling artist of the 'London Illustrated News,' went seven miles out of the way through the pine forest on horseback to see the *big trees*, as they are called. This was on the 9th May last (1873). With regard to the altitude at which the trees are grown I cannot inform you exactly, but it could not be less than from 5000 to 6000 feet above the level of the sea. The highest of the trees, the guide told us, were over 300 feet high; but in a forest, with other trees intervening to obstruct the sight, it is difficult, on getting to a proper distance, to get a full view of any tree in particular so as to form a judgment of its actual height. The big trees all had the appearance of being withered or withering at the top, and their height did not at all correspond with their circumference. As my object in going to see the trees was more for pleasure than with any scientific purpose, I was not provided with a measuring line to take the dimensions of any of them, but for curiosity, the three of us and the guide *with our horses*, got as close as we could to the root of one of the largest, and we did not half encircle it."

It is a curious fact that two cones of the genus *Sequoia* (Wellingtonia) have been found in a fossil state in this country. May we not, therefore, in introducing this tree be only restoring to the flora of Great Britain one of its former treasures, now long extinct, and unknown for countless ages?

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XXII. *The Self-Sown Oak Woods of Sussex.**

By RALPH W. CLUTTON.

In this paper I propose to inquire into the following matters connected with the growth and management of self-sown oak woods. Oak will grow in almost any description of clay, from the poorest and stiffest to a good deep loam. As the oak, in its earliest stages of growth, has a long tap-root, a deep soil, free to a certain depth from rock, is necessary to its rapid development. Oak will grow with considerable luxuriance in a gravelly soil, but, on arriving at a size fit to be called timber, it becomes what is termed shaky, and it will be found on felling to be little more than a bundle of laths, utterly unsuitable for the uses to which oak timber is generally put.

The Position of Oak Woods as affecting their Growth.—There is no tree grown in England more sensitive of exposure to wind than the oak, and the best and fastest growing woods are those in sheltered positions, well inland. There is a tract of country in the south-east of Sussex, lying between Battle and Hailsham, the soil of which is well adapted to the growth of oak, but which, from its nearness to the sea—about ten miles as the crow flies—fails to produce, except in very deep narrow gills, other than short stumpy trees with bushy boughs, evidently thrown out as a protection against the south-west wind. These trees produce knotty and unsaleable timber. About thirty or thirty-five years ago, the planting in St Leonard's Forest was begun with larch and oak, the proportion being about five of larch to one of oak. Since the larches were seven or eight years old, they have been gradually thinned out, and, though in no case have they thoroughly disappeared, the land is fairly planted with straight-grown silver-rinded tellars, which bid fair in due time to become a fine oak forest. This land is ordinary forest land.

Effect of the Periodical Cutting of Underwood.—The periodical cutting of underwood affects the growth of trees, as it affords the only opportunity of thinning woods; thus the thinnings are at longer intervals than, perhaps, is best for the growth of oak timber. The custom in the Wealds of Surrey, Sussex, and Kent is to cut the underwood at intervals of from eight to twelve years. Underwood is usually sold by auction in November, and in the following

* An abstract of a paper read at an ordinary general meeting of the Institution of Surveyors, February 16, 1874.

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spring the oak trees are inspected, and such thinning as is required is then done. If the timber only was considered, a shorter interval of, say, five or six years, would be better; but as the underwood is an important portion of the profits, it is impossible to make the most of it until it becomes large enough for conversion into hop-poles, hoops, &c. As to the age at which the timber causes injury to underwood, supposing there is a full plant of tellars at any given fall, for the next two cuttings (say, for twenty years) there will be little difference found in the value of the underwood, which averages from L.8 to L.10 per acre. The next three cuttings will be reduced, on an average, about one-half, and afterwards the periodical cutting will be sold for a very small sum, viz., L.1 to L.1, 10s. per acre, which will not pay for rates, fencing, and ditching.

Pruning Oak Woods.—Not only is pruning unnecessary—for, if thinning is done gradually, allowing the oak trees to draw each other up to such height as may be required, the lower branches will of themselves drop off—but it is actually injurious, as every timber merchant or village carpenter knows. And the boughing of oak trees materially affects the value of the timber when felled, though the tree, when pruned, may be only 20 or 30 years, and, when cut, 150 years old. When the boughs are thrown off by nature, as they are most perfectly under careful management, the bark gradually closes over the part from which the bough dropped, and it becomes impossible to define the former position of the bough, nor would any sign of it be found when the tree is cut; but, should the tree be pruned, an unsound knot, or a sore in the tree, is at once formed, allowing the water to penetrate the trunk where the branch was cut off. This will rot, and a black dead piece of wood will be found in the centre of the tree when it is cut. The bark will, no doubt, usually close over the wound made; but this will take some years, and, before it is closed, the mischief will be done; and, in old trees, it not unfrequently happens that the perfect closing over the wound by young wood causes a species of dry rot.

Thinning and Clearing.—As I stated above, the time for thinning woods is when the underwood is cut. The greater part of the timber of the weald in question is grown with underwood. The underwood is cut, on an average, once in ten years. At each cutting, trees which have attained a good size, and show symptoms of diminished growth, are felled, and open spaces are thus obtained for a fresh crop. The same opportunity is taken for thinning the young tellars, and of saving such further young plants as have come up since the

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last cutting of the underwood, that is, ten years previously. In thinning tellars and young trees, it is of the utmost importance that the leading trees should be left, and the inferior ones cut. For the ultimate crop the trees should stand from 20 to 30 feet apart. The great aim of every forester should be to keep the trees thick enough to draw each other up to the height required, so as to have a clear stem of from 20 to 40 feet, as the case may be, and so to gradually thin them as not to abruptly admit the wind, and thus cause them to be checked in growth. Any checking of growth is speedily detected by the throwing out of a quantity of "rushy" boughs, as they are called. We have now carried our wood up to the age of from seventy to eighty years. If the trees have been properly managed, little further thinning will be required until their clearing, unless the timber is left for a longer period than 100 years for large shipbuildings. After a wood has been cleared of a natural crop of oak, and the underwood has grown for a period of ten years, it will generally be found, at the next cutting, that a good crop of self-sown oak tellars is fairly scattered over the ground. The tellars are usually marked with paint, and are excepted from sale. At this first cutting the young oak trees will be about the same height as the underwood; and, if the underwood is fairly good, the chances are that it will be unnecessary to thin the tellars at all, more than by a woodman going round and chopping down with a hatchet any inferior trees. During the next five or six cuttings the real work of thinning must be executed.

Profits.—I now come to the question of profit, whether timber or underwood pays best, taking a certain period of time, say 100 years. Assume an acre of underwood of a fair average description in Kent, Surrey, or Sussex, no oak trees being allowed to be grown upon it, but kept entirely for underwood. I will suppose that it has a good set of stems upon it. This underwood is worth, to sell, upon an average of L.10 per acre at ten years' growth; and it may be assumed, for the purpose of rental value, that underwood selling for L.10 or L.12 per acre, is worth the same number of shillings rent; this will be found a close approximation if worked out. This acre of woodland will therefore produce a rent of 10s. per annum, and go on producing the same description of underwood for the 100 years with occasional filling up. Take, secondly, an acre of woodland under similar conditions with regard to underwood, but allow tellars to grow upon it; there will be found little or no difference in the value of the underwood for the first twenty years. During the next forty years the

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underwood will have diminished in value; but we may fairly calculate that the trees which have been cut in the course of thinning, after twenty years, will have made up any loss in the value of the underwood in this period. In fact, the produce is much more than enough to make up the loss of profit from underwood. For the remainder of the 100 years the underwood will pay very little, and the thinnings will not produce more than enough to pay expenses. In the foregoing observations I have assumed that underwood sold at L.10 per acre is worth a rental of 10s., and that for sixty years the underwood and tellar thinnings together will produce fully 10s. per acre. From the latter period, and up to 100 years, when I assume the timber will be fit for felling, little or no revenue will be derived. The rental of 10s. per annum accumulated for forty years at 4 per cent., gives, in round figures, L.50 per acre. The following is an instance of a wood of 4 acres near Reigate, which was planted in 1830 with oak and other trees. I have no record of any thinnings prior to 1866. In April 1866, twenty-eight oak trees, containing 111 feet, and 208 tellars, were cut and sold for L.42. In April 1872, thirty-nine oak trees, containing 216 feet, were cut and sold for L.21. In 1873, seventy oak trees were cut which were valued at L.40. This wood was sold, and the timber on it valued very accurately, in 1872. There were 375 oak trees, containing 2600 feet of timber, and a few other trees, valued together at L.247, being at the rate of L.60 per acre. The above sum of L.60 per acre gives a rental of 11s. per acre at 4 per cent., and beyond that, of course, is the sum of money received for the thinnings. The trees in this wood will not require much more thinning. It is, I think, apparent that the oak-growing districts, in which underwood and timber are grown together, produce a much larger profit on an average of 100 years, than it is possible for oak plantations alone to produce, as, during the earlier periods of growth, underwood pays an income when the land planted with oak pays nothing.

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XXIII.—*Address delivered at the Twenty-first Annual Meeting.* By HUGH CLEGHORN, M.D., F.R.S.E., late Conservator of Forests, Madras.

GENTLEMEN,—The time has again returned when, according to custom, a word of encouragement, and I hope I may say of instruction, is wont to reach you from this chair. Twice you have been pleased to elect me your President, and this is the third time that I have been called upon to address you at the Annual Meeting.

The framing of an annual address is no easy task, and many general subjects suitable to bring to your notice have been discussed over and over again by my predecessors. Perhaps, however, I cannot do better on this occasion than refer briefly to the rise and progress of arboriculture, and advert to some facts and proceedings in this and other countries which bear upon the advancement of the science which has brought us together to-day.

I think that our Society has reason to regard its quiet progress during the past year with some degree of satisfaction. The roll of members has received a considerable number of working recruits, and the new part of our Transactions contains some excellent articles, and quite sustains the character of its predecessors. There are fifteen essays to be reported upon by the judges to-day, relating to nine subjects offered for competition, and only five of the subjects advertised have not been taken up.

Arboriculture comprises all that relates to the culture of trees, and is one of the great divisions of agriculture. It is a branch of rural economy of much more recent date than either the culture of grain and herbs, or the breeding and rearing of cattle. The cultivation of those plants which supply the food of man and of the domestic animals occupied his attention exclusively for many ages; whilst the timber required for houses, ships, machines, and for fuel, was found in the native woods. Artificial plantations appear to have been formed in Germany sooner than in any other country, apparently in the fifteenth century. In Britain planting was begun, though sparingly, a century later.

The Hon. G. P. Marsh ("The Earth as Modified by Human Action, 1847, p. 307") thus describes the condition of Britain in the sixteenth century, when wood fuel began to be scarce:—"Contrivances for economising fuel were of later introduction in this country than on the Continent. Before the introduction of

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a system of dainage, the soil, like the sky, was, in general, charged with humidity; its natural condition was unfavourable for common roads, and the transportation of so heavy a material as coal by land, from the remote counties where alone it was mined in the Middle Ages, was costly and difficult. For all these reasons, the consumption of wood was large, and apprehensions of the exhaustion of the forests were excited at an early period. Many authors of the sixteenth century express fears of serious evils from the wasteful economy of the people in this respect." Harrison, in his curious chapter "Of Woods and Marishes," date 1550 A.D., in Holinshed's compilation, complains of the rapid decrease of the forests, and adds:—"Howbeit this much I dare affirme, that if woods go so fast to decaie in the next hundred year of Grace, as they have doone and are like to doo in this, . . . it is to be feared that the fennie bote, broome, turfe, gall, heath, firze, brakes, whinnes, ling, dies, hassacks, flags, straw, sedge, reed, rush, and also sea cole, will be good merchandize even in the citie of London, whereunto some of them euen now haue gotten readie passage, and taken vp their innes in the greatest merchants' parlours. . . . I would wish that I might live no longer than to see foure things in this land reformed, that is: the want of discipline in the church; the couetous dealing of most of our merchants in the preferment of the commodities of other countries, and hindrance of their owne: the holding of faires and markets vpon the sundaie to be abolished and referred to the wednesdaies: and that evrie man, in whatsoeuer part of the champaine soile enjoieth fortie acres of land, and upwards, after that rate, either by free deed, copie hold, or fee farme, might plant one acre of wood, or sowe the same with oke mast, hasell, beech, and sufficient prouision be made that it may be cherished and kept. But I feare me that I should then liue too long, and so long, that I should either be wearie of the world, or the world of me." (Holinshed, reprint of, 1807, i. pp. 357, 358.) It is evident from this passage, and from another in p. 397, that though sea coal was largely exported to the Continent, it had not yet come into general use in England. "It is a question of much interest when coal was first employed in England for fuel. I can find no evidence that it was used as a combustible until more than a century after the Norman Conquest (1150 A.D.). It has been said that it was known to the Anglo-Saxon population, but I am acquainted with no passage in the literature of that people which proves this. . . . Coal is not mentioned in King Alfred's Bede, in Glanville, or in Robert of

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Gloucester, though all these writers speak of jet as found in England, and are full in their enumeration of the mineral products of the island."*

Planting was not general in Britain till the end of the seventeenth century, when the introduction of exotic trees was facilitated by the interchange of plants by means of botanic gardens, which in that century were established in various countries. The Botanic Gardens at Oxford and Chelsea, the oldest in England, were in existence in the middle of the seventeenth century, and the Edinburgh Botanic Garden was founded nearly two hundred years ago, though it was only in 1822 that it was established in its present site. Evelyn's "Sylva," which appeared in 1664, gave a great stimulus to arboriculture, and there is no doubt that the ornamental plantations in which Britain surpasses all other countries, are in some measure the result of his labours in this direction.

During the general war at the beginning of this century, the price of timber became very high, owing to the greatly increased demand, and the difficulty, from the unsettled state of affairs, of obtaining supplies. Under the expectation that such prices were to continue, planting was by very many in Britain ardently undertaken and carried out. It has, however, long been evident that capital invested in this way does not yield an early return; hence the rage for planting merely with a view to profit has declined, but there is a greatly increasing taste for the planting of parks and pleasure grounds, and for the introduction of trees and shrubs from foreign countries.

The rapid growth of the timber trade in the last decade might be illustrated from official records: while our hedgerows have been stubbed out and our strips of planting disappear, often unwisely, to make way for cereal crops and rearing of stock, foreign timber, now so essential to our constructive requirements, has been extensively imported from many quarters.

The Board of Trade returns show how great and increasing is the annual importation of timber, and that the production within our own island is comparatively insignificant. The supplies on our East Coast are obtained from Norway, Sweden, and the Baltic ports, while the wants of our western market are met with timber from the great continent of America.

The following table shows the total imports and their estimated value during the last three years:—

* See also Evelyn's Diary, ii. 25, 26.

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	Quantity.			Value.		
	Year ending 31st December.			Year ending 31st December.		
Timber (Hewn).	1871.	1872.	1873.	1871.	1872.	1873.
	Loads.	Loads.	Loads.	£	£	£
From Russia . . .	191,280	258,879	340,702	399,955	559,112	810,284
Sweden and Norway	462,225	509,898	700,097	810,216	910,448	1,551,536
Germany	334,290	275,125	262,818	841,557	854,887	1,009,107
British N. America	451,312	443,484	365,875	1,807,959	1,798,441	1,806,642
Other countries .	209,528	295,247	401,898	822,478	1,047,140	1,504,799
Total	1,648,635	1,782,633	2,071,390	4,682,165	5,170,028	6,682,368
Timber (Sawn or Split, Planed or Dressed).						
From Russia . . .	515,596	634,677	754,666	1,239,170	1,530,745	2,239,243
Sweden and Norway	1,491,988	1,523,195	1,535,852	3,012,345	3,349,616	4,431,184
British N. America	703,800	788,288	954,356	1,830,446	2,206,405	3,130,185
Other countries .	137,117	141,189	170,849	430,265	486,897	723,896
Total	2,848,501	3,087,349	3,415,723	6,512,226	7,573,663	10,524,508
	Loads.	Loads.	Loads.			
Staves (all sizes) . .	88,119	66,102	86,438	606,854	642,046	854,115
Mahogany (tons) . .	29,256	33,291	52,343	280,134	367,471	604,001

—*Timber Trades' Journal*, vol. i. p. 244.

There are several subjects connected with the pursuits of our Society upon which much information has been elicited during the past year to which I shall simply refer before passing on to what is doing in other countries. The "Timber Trades' Journal," a fortnightly paper, has recently been established for the purpose of affording a medium of intercommunication between producers and consumers of wood at home and abroad. It contains much reliable information regarding the principal timber markets in Europe and America. The "Gardener's Chronicle" and "Agricultural Gazette" have also during the year had many articles on the subject of forestry, contributed by well-known members of this Society. Our friend Mr M'Nab has drawn attention to two subjects of considerable importance:—1st, The disfiguration of roadside trees by the unskilful lopping to which they are subjected to make way for telegraph wires ("Bot. Soc. Trans.," xi. 453); 2d, The preservation of remarkable or old trees ("Bot. Soc. Trans.," xii. 44 and 96), which appears to be a matter coming within the scope of our Society, on which his matured views might find expression in our Transactions. Sir Robert Christison has vigorously laboured in the same direction, expiscating the records of old trees and measuring the dimensions of the fossil plants in this neighbourhood ("Roy. Soc. Trans.," xxvii. 203,

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and "Bot. Soc. Trans.," xii. 167). An interesting work by Mr Menzies, Deputy-Surveyor of Windsor Forest and Park, is in the press ("Forest Trees and Woodland Scenery, as described in Ancient and Modern Poets"), which contains much useful information, and depicts in chromo-lithograph some of the finest specimens of trees in the royal demesne.

The use of steam-power in uprooting trees has been adopted in some districts, with a view to economising labour in stubbing out the roots; but there can be little doubt that the timber, especially of soft-wooded trees, is materially damaged by the process, and the depreciation in value must be set against the diminution of labour.

It is a source of great regret to me that I have never visited the forests of North America, which have given to us so many of the trees successfully cultivated in this country, such as the Weymouth and Douglas pines, *Cupressus Lawsoniana*, the gigantic *Sequoia*, *Taxodium Sempervirens*, the tulip-tree, snowberry, and many others.

When the first settlers landed on the shores of the western world, they found the country covered with primeval forests, which had to be felled and cleared to make room for their settlements and the production of food. The supply of wood was then considered inexhaustible; as cultivation proceeded westwards, new forests revealed themselves, stretching far beyond any knowledge which the settlers possessed of their extent. Gradually the great lumber trade of Canada and the United States sprang up, which has supplied our western ports with timber for ships and houses. The wants of the great American continent itself, with its rapidly-increasing population and its enormous export trade, have meanwhile grown immensely. The unparalleled facilities for internal navigation afforded by the numerous American rivers, have proved fatal to the forests, which have become so sparse in accessible situations, that at last it has been found necessary to legislate for the preservation of what remains; and in place of a superabundance of wood, matters are thus described ("Gard. Chron." 1847, vol. ii. 459:—

"Lumber operators and consumers in Pennsylvania are awakening to a knowledge of the important fact that the timber resources of the province are not inexhaustible, as they have long been considered. The State was once one of the leading pine producers in the Union. The dense forests bordering the Susquehanna, and traversed by its many tributaries; the mountains of the Monongahela Valley; and, in fact, the tall, majestic trees that covered thickly much of the area of whole counties in the State, were a few

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years ago thought to contain pines enough to comply with the law of supply and demand for the present, and to furnish timber for a future, however distant. That impression the march of events has thoroughly dispelled. The forests of the Delaware Valley have yielded no pine for years, and the resources of the Alleghany and Monongahela have been drawn so largely to supply the markets of the East, that in a comparatively short time their pine forests will be exhausted. . . . A significant and alarming fact is, that the coal regions, once famous pine-producing counties, cannot now supply enough to furnish timber for props for the mines. From supplying all home demands and exporting large quantities of pine, these counties have become importers, paying more per thousand for what they purchase than they obtained when selling the same product. . . . Taking a liberal estimate, less than four years will exhaust the pine supply of the Susquehanna Valley, and the now comparatively neglected hemlock spruce (*Abies Canadensis*) will become the staple in the lumber trade of that section, as it has been for years in the Delaware region."

"In a few years the great lumber marts of the East must necessarily depend entirely on the great forests of the West, and the rapidly-decreasing pinewoods of the South. Are these inexhaustible? Is not the fact that the once mighty pine-producing State of Pennsylvania is so nearly bereft of this great source of wealth, that the date of its exhaustion is easy of computation? There is ample food for reflection on the importance of timber culture in this country contained in these facts."—*Montreal Gazette.*

Let us turn to the forestal condition of the southern provinces of France, the climate of which, as compared with Britain or the northern states of America, is extremely mild. Little snow falls except on the mountain ranges; the frosts are light, and the summers are long. The fig and vine flourish everywhere, the olive up to 43° N. Lat., and on the south coast the orange, lemon, and date-palm grow freely. The forest trees are of a southern type, such as the umbrella pine; various evergreen oaks and many broad-leaved trees of persistent foliage characterise the landscape. In the seventeenth century it was found that there was an increase of prosperity and of population in Lower Provence, while there was an alarming decrease in the wealth and population of Upper Provence. Much land had been rendered arable by clearing of the forest, but it was found that the augmented violence of the mountain torrents (from the Alps) had buried in sand and gravel more land than had been reclaimed

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by clearing. In 1843 the political economist Blanqui graphically described the great evils which follow extended clearing, and ravages of torrents, where there is not a bush to shelter a bird, and where, when a storm bursts over the mountains, masses of water deluge the valley, overflowing the fields and stripping off the soil. The attention of the State was earnestly directed to the evils of denudation and the action of torrents; and the measures of the French authorities have been vigorous and successful. The conservative action of the woods has been generally recognised by the public of France, and the government has enacted laws for the protection of existing forests and for the formation of new ones.

The quantity of timber required in France is enormous, and the serious point is that the increase in the consumption is in inverse proportion to production. Dearth of wood is certain in the future, unless determined action be taken to replant and bring waste land under forest cultivation. The consumption of wood in the coal mines of France is very large; a great part of the supply is obtained from Switzerland and Savoy, and the cost increases annually. One mining company has purchased all the available land fit for growing timber in the neighbourhood, and already possesses a fine young forest of considerable extent (3000 acres). The government devotes annually a certain sum to replanting forest land, but this is found to be quite insufficient; it therefore seeks to stimulate private enterprise by offering grants and rewards to those who cultivate or extend their forest lands.

It is well known that other countries are not so well supplied with timber as formerly. Russia, Sweden, and Norway, which have to a great extent met the demands of our eastern ports as well as those of the northern coast of France, have begun to consider the state of their forests, and to regulate the annual felling of pines.

Let us now turn for a moment to the state and progress of forestry in British India. On referring to "Loudon's Encyclopedia of Gardening," Edinburgh, 1850, a work constantly consulted by all who are interested in arboriculture and horticulture, I find Indian forests summarily disposed of in the following passage, p. 304:—"Forest trees do not naturally abound in Bengal; the teak tree *Tectona grandis*, is the oak of the East, and grows in abundance in the hilly kingdoms of Burma and Pegu, whence Calcutta is supplied for the purposes of naval architecture. Whether it will ever be found worth while to cultivate this tree in Bengal appears very doubtful. The bamboo is the timber used in the general

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economy of the country." About the time this was written (1850), the Government of India began to be seriously embarrassed by the scarcity of timber; its attention was directed to the management of the indigenous forests, and as you are aware a special department has been organised within the last twenty years in that great empire, charged with the care of the wood, and a considerable number of trained assistants have been sent out, who are introducing correct principles of management. As the administration of the forests advanced, the want of hand-books to enable officers to acquire a knowledge of the trees, shrubs, climbers, &c., in their ranges was increasingly felt, and nothing perhaps indicates so clearly the growing importance of that department, as the almost simultaneous appearance of two illustrated works of great value on the trees of India, published lately under the auspices of Government. These are Stewart and Brandis' "Forest Flora of North-West, and Central India," and Beddome's "Flora Sylvatica of Southern India." A forest flora of British Burma by S. Kurz, Curator of Herbarium at Calcutta, is now in preparation. These three books comprise descriptions of most trees, a knowledge of which is needful to foresters in British India.

On a former occasion, I alluded to the diversified duties falling to the lot of a forester in India, and to the fact that his range of observation is wider than that of a forester in Britain. It should also be borne in mind, that owing to the ease with which books of reference are obtained in this country, you have the advantage over him. The European forester has to deal with comparatively few trees, and trustworthy information on all of these is readily procured. The forester in India, on the contrary, has to do with perhaps a couple of hundred trees and shrubs yielding timber and various minor products, as dyes, fibres, oils, gums, &c., but he has been without the means of finding out the value of the products around him, except by the purchase of costly and rare books. His forest range may be in great part uninhabited, and even in well peopled districts only partial information is to be obtained—products which are collected and give profitable returns in one range being unknown or neglected in others, as, for example, the Catechu and the Sappan. Again, *Gmelina arborea*, which occurs in almost all the forests of South India, is appreciated as yielding valuable timber in one or two districts, but is supposed to be of little or no value in others. Many such instances might be given.

As Dr Brandis states in the preface to his "Forest Flora" (p. ix.),

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some "hold that the sole legitimate duty of forestry in India is to provide fuel and timber, and that the forester has no concern with bark, lac, gums, resins, caoutchouc, wax, oil, dyes, fruits, and other marketable products of trees and shrubs. Such views will continue to be maintained until it is generally acknowledged that the principal aim and object of forest management in India is the formation of public estates, to be managed so as to secure large benefits to the country of an indirect nature, as well as a continuous and increasing yield of all descriptions of forest produce necessary to supply the requirements of the people and their export trade. Foresters in India will gradually understand that they are expected to make the utmost of the estates intrusted to their charge for the benefit of the present generation, while steadily improving the capital value and productiveness of their estates; and this will lead them keenly to seek information regarding the various trees and shrubs which may be turned to account. It is not possible to predict in what respect any particular plants may not eventually be found useful, either by their produce, or because they further the growth of the more useful kinds by their shade and shelter, or in other ways. The only safe plan, therefore, is, at the outset, to take a comprehensive view of the whole forest vegetation, instead of confining our attention to those trees which we are accustomed, often erroneously, to regard as most important."

For besides the forests considered with special reference to the value of the trees for manufacturing purposes are others called "fuel forests," in which the timber is used almost entirely for burning. In the Central Provinces, Bombay, Berar, Madras, Mysore, and Burma, "all the inferior woods, that are not specially protected, are cut and used for the fuel supply. But even in the thickly-wooded provinces provision has to be made for projected lines of railway, and in Burma fuel reserves have, with wise forethought, been set apart along the Prome road. The regular demand for fuel of any organised steam service soon makes itself felt. The Irrawaddy steamers have required large supplies of wood, and already tracts of 'Eng' (*Dipterocarpus*) near the river in the Prome district have been denuded, and the fuel stacked in 1873 consisted of wretched billets of thin saplings. *Acacia Catechu*, the valuable wood that yields the catechu of commerce, was ruthlessly cut for this purpose." The wood of many other trees is commonly used for fuel. "With regard to other products, such as gums, resins, fibres, dyes, &c., in some provinces they are of much greater value

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than in others. In the extreme north the value of these minor products, as they are called, is comparatively insignificant. The Himalaya could yield large supplies of resin, but the difficulty and cost of transport to the plains have hitherto prevented anything being done in this direction. The Punjab has hardly anything worth speaking of; gum from the *Acacia arabica*, *Odina*, and other trees is collected for local use. A little lac is collected in some districts, but very inferior to that of Central and Southern India.

"These minor forest products yield a large revenue in the sub-Himalayan forests, especially in the districts of Kumaon and Garhwal. A system of revenue has been established in these places with marked success, the collection of all sorts of articles of minor produce is allowed; while at the same time all destructive processes, such as the felling of large trees, lopping for resin, &c., are prohibited. Any one may collect these products, "but the forests are so situated that when the exporter leaves the place he must pass by certain routes on which toll-houses are established, and at these his collection is overhauled, and made to pay certain seigniorage rates, according to a fixed and published scale." Amongst the produce so collected are solid and hollow bamboo stems, used for walking-sticks, pipes, boxes, &c.; *Eriophorum cannabinum*, used for ropes; various kinds of reeds, used for matting and for thatching houses; also the numerous gums; the resins of the Sal and other plants, the fruits of *Feronia elephantum*, the Chiretta (*Ophelia chiretta*), a Gentianaceous plant, used as a febrifuge and tonic, which is becoming more and more in repute in this country; Myrobalans, the fruits of *Terminalia Chebula* and *T. Bellerica*, largely imported for tanning purposes; kamela, the red powder obtained from the capsules of *Rottlera tinctoria*, and used both as a dye and as a vermifuge."*

In January of this year a conference of forest officers for the discussion of questions connected with forestry was held at Allahabad, and the proceedings have been fully reported in a volume printed by Government, which constitutes a remarkable contribution to forest literature. The report is edited by Messrs Baden Powell and J. S. Gamble, and prefaced by some comments from the pen of Dr Brandis. The subjects discussed had reference to forest legislation, the relation of forest officers to civil officers, forest revenue, the required forest area in each province, the questions of forest rights and forest licences, the method of planting in the Himalaya, the present state of the Deodar forests, &c. It is proposed to hold another confer-

* Notes on Indian Forest Produce in "Gard. Chron. 1874," vol. ii. p. 490.

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ence at Simla in September 1875, and the publication of a quarterly Forest Magazine was resolved upon.

In glancing through the report of this conference it is striking to observe that the same conclusions are arrived at in some points of forest management, as those obtaining in this country under very different circumstances. For example (p. 194), the nursery culture and planting out of Deodar in the Himalaya appears to be very similar to the system most approved in Scotland, as to its congener the larch. "We all agreed that the proper system would be as follows: seed to be sown in nursery beds in November. Seedlings to be bedded out at three inches apart in July following; these seedlings to be transplanted at six inches apart at the commencement of the following rains to remain for twelve months, and then to be finally planted in the forest at four feet apart."

Again the difficulty of confining the rivers in flood within their banks has been great, especially in the sandy districts of Sindh and the Punjab. The following extract from the Report on the Administration of the Punjab Forests for 1872–73, shows that the plan successfully carried out in this country has been adopted on a larger scale in India:—

"A stream, which during the rains becomes much swollen and rapid, runs through the middle of this Bela. During 1871–72 a quantity of land was cut away by the action of this stream, and this year I was determined to do something, if possible, to prevent such damage in future. Accordingly, when the stream was at its lowest, I caused the almost perpendicular bank to be sloped at twelve feet from the old bank and the slope afterwards planted with willow slips at one foot apart. This method has up to the present time—and we have had a heavy flood—acted admirably, even beyond my expectation. Not in a single instance has the slope been broken, and the willow slip and grass having now taken good root, I have no fear for the future. Altogether it is a great success, and I think that more attention should be paid to this branch of forest work, especially with reference to the Belas, the banks of which might, in my opinion, with little difficulty, be made perfectly secure."

In conclusion, I call upon you, especially the young country members, to make good use of the opportunities afforded to you to-day, examining both the museum and the garden, which are arranged with skill and judgment, and which at a glance tell of the eminent and enlightened men of science who have been charged

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with their formation and maintenance. I trust that the visit may be profitable to you, that the faculties of observation will receive a healthy stimulus and be brought into vigorous exercise, and that you will go home with enlarged views of your calling. Perhaps some influence may lead you, or some dormant power of brain be stirred within you, which after diligent study and patient perseverance may raise you to the rank of a Loudon, a Macnab, or a M'Corquodale.

Geology and botany, chemistry and surveying, are all useful studies to the young forester desirous of rising in his profession, and are sciences of which the smallest amount of sound knowledge cannot fail to be of service.

I understand there is a proposal for the enlargement of this beautiful garden with a view to the formation of an extended arboretum, a scheme which while adding to the usefulness of the garden for educational purposes, will also contribute to the amenity of the city.

I have once again to thank you for having placed me in this honourable position, and before vacating the chair, I would take the opportunity of expressing my great gratification in learning that it is, I understand, the unanimous feeling of the Society that Professor Balfour be your president-elect. By having his name in this way associated with you, honour will be done to the Society, and a just tribute paid to his life-long interest in the success of arboriculture.

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XXIV.—*On the Literature of Scottish Arboriculture.*

By ROBERT HUTCHISON of Carlowrie, F.R.S.E.

The utility of timber for the supply of an infinite number of man's wants, and its adaptation to his varied domestic and constructive necessities,—applicable as it is to his earliest and to his latest requirements,—to his cradle or to his coffin,—has rendered the growth and culture of trees in every age and in every country throughout the civilized world a subject of primary importance. Nor is the culture of timber trees a topic of an uninteresting nature, apart from the consideration of their utility, for the advantages afforded by their shade and ornament are recognised in almost every country; and the avidity with which, everywhere, the flora of distant regions is ransacked for new acquisitions suitable for a wider geographical area of distribution than nature has allotted them, proves that the love of trees, *per se*, is one of the deepest and earliest impulses of human nature. If this, then, be the case, it must be little matter of surprise that artificial skill and ingenuity, even in rude untutored ages, were called forth to foster and promote, by every conceivable device, the cultivation of the most useful varieties of trees, whether for food, fuel, or mechanical employment, according to the respective wants of the grower. Arboriculture may thus be looked upon as the oldest of all pursuits or occupations; and although its literature, strictly so called, may be of comparatively modern growth, yet its *unwritten* history is cœval with the existence of man upon the earth. Our common forefather, Adam, was himself a practical arboriculturist, and it would be extremely curious to us now to know what were the principles by which he and his immediate descendants were guided in their propagation and treatment of trees. Their knowledge, however, doubtless handed down by oral tradition,—for as far as we know, *writing* was an undiscovered art in that early period,—would, by its diffusion, become changed, and their modes of operation altered, so that we may be assured the wisdom of our first parent and his more immediate followers died in a great measure with themselves. Still we have in the sacred Scriptures glimpses that show us how, in the dim past, our forefathers laboured as we labour, and interested themselves in the very same pursuits in which we occupy ourselves; and probably, in spite of modern arrogance and pride of civilisation and wisdom in our nineteenth century, their knowledge, if not as extensive, was perhaps quite as accurate as ours upon all the elementary teachings

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of plant or tree life and culture. Had the book in which king Solomon "spoke of everything" that grew, "from the cedar which is in Lebanon, even unto the hyssop that springeth out of the wall,"* been still in existence, modern arboriculturists might have found much to repay them for its perusal; but in common with much that might have made us humbler and wiser, this treatise by the wisest of men has perished, and we are forced to deduce the principles by which our early forefathers were guided, by simply observing the results of their actions.

All early history shows that trees were carefully cultivated, and particular attention paid to their preservation. Their planting and felling formed subjects of legal enactment even in the remotest centuries, and continued to be so in many countries down to comparatively modern times; while even at the present date, in several continents and empires, State protection to the forests and woods is found to be absolutely essential. In the Mosaic law, for example, we read† that the Israelites were forbidden, in time of war, to cut down trees of any besieged city by forcing an axe against them, lest they should destroy trees of which they might eat; for the tree of the field is man's life. In the early history of many other nations and peoples, we also see that trees were considered and valued. Indeed, in days when the multifarious purposes to which iron can be applied in place of timber were unknown, in peace and in war, tree growing must have been a matter of intrinsic importance; and arboriculture, as a science, must have been studied to some extent, and well understood, although its practice was not reduced to writing, but preserved by oral tradition, and by the successful results of their own and their fathers' experience.

But while it would be very instructive, and no less deeply interesting, to trace out the early history of the literature of arboriculture among all the nations of the old world, we must, for the present, confine our attention in this paper—to endeavouring to decipher, in a cursory manner, its early growth and progressive advance in our own land,—and to investigating both the difficulties it had to contend against, and the advantages accruing from it at the present day.

The earliest distinct glimpse of the internal condition and rural economy of Britain which we have may be dated from the invasion of our island by the Romans in A.D. 78, and although the primitive inhabitants of the country were totally ignorant of any mode of transmitting their ideas other than by word of mouth, yet the

* 1 Kings iv. 33. † Deut. xx. 19 and 20.

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invaders, belonging to a race far advanced in civilisation and in the arts and sciences of the period, and boasting in their literature some of the most famous authors and philosophers the world has ever seen, have handed down to us a clear and vivid picture of the condition of this island, and its inhabitants, and their occupations, when they first landed upon its shores. We learn from their records that Britain was then in great part covered with dense forest. Julius Cæsar, the leader of the Roman legions, who took possession of the island, says:—"A town among the Britons is nothing more than a thick wood, fortified with a ditch and rampart, to serve as a place of retreat against the incursions of their enemies." Strabo also, in describing a British town, says:—"Forests were the only towns in use among them, which were formed by cutting down a large circle of wood and erecting huts within it, and sheds for cattle." Groves were also used by the ancient Britons as places of worship; and the altars of the Druids were generally erected in woods, and the oak was regarded by them as a sacred tree. That this densely wooded condition of ancient Britain had existed from very early ages, is quite apparent from the number of whole trees (fir chiefly) frequently found embedded in deep bogs, conclusively proving that many centuries ago, the wolf and the boar roamed unmolested through deep woods and tangled thickets; that the wind, tearing its way through the mighty forest, swept down the trees in its course, and these being unvalued and unmissed, were allowed to lie till the fallen leaves of centuries, silently gathering over them, shrouded them from sight, to be dug up afterwards, in distant years it might be, as the silent historians of far off ages. Assuming, then, that the general condition of Britain, at the time of the Roman invasion, was chiefly that of a forest, or series of forests, and knowing the proficiency of the Romans in all gardening and rural matters, we may very naturally suppose that they taught and introduced many new modes of propagation of timber trees, and various original methods of treatment of them. For the Romans had long been celebrated in the art of gardening, and in the culture of trees; and, indeed, all the nations of antiquity were uncommonly fond of gardening and such like occupations or recreations. Hence we read of the fabulous gardens of the Hesperides, so beautifully described by Virgil,* and of other equally famous gardens and grounds mentioned by other authors,† and repeatedly quoted or referred to when

* Virgil, Æneid, iv. 484.

† Ovid, Am. i. 10, 56. Stat. Sylv. i. 3, 81. Plin. xix. 4. Cic.. Att. xii. 23. Horat. Od. ii. 14, 22; *et* ii. 15, 4.

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ideas of pleasure or scenes of blissful delight were desired to be conveyed to the mind of the reader. Virgil, moreover, enumerates the various ways of propagating trees and shrubs, both natural and artificial (Geor. ii. 9), common in his time; and we find, upon a close survey of the writings of the old classical authors, that the usages in vogue in those days for the cultivation of timber trees and shrubs were much the same as we now insist upon at the present time. Propagation by seeds, layers, suckers, "sets," slips or cuttings, grafting, budding, or "inoculation" (Plin. xvii. 16, s. 26), were all well known and practised very extensively. Forest trees were chiefly grown from seeds. The practice of cutting over coppice to sprout again from the stool (*succisæ repullulant*) was quite common (Plin. xii. 19). We have also reference made by Pliny to the existence of a trunk of larix or larch, 120 feet in length, and 2 feet in thickness (Plin. xvi. 40, s. 74). The art of transplanting trees also received due attention, and indeed seems to have been carried on (as many other forest operations were) with careful regard to physiological principles. Thus, for example, we find that in removing trees from one site to another, the Romans marked upon the bark the way each tree stood prior to removal, so that it might, in its new situation, point to exactly the same quarter of the heavens.*

These, and other authorities and facts which might easily be cited, show us how far advanced in the science of arboriculture were the Romans at the time of their invasion of Britain, and we may easily conceive the intelligent observation they would bring to bear upon the woods of the new country they wished to conquer, and the knowledge they would impart to the untutored savage inhabitants of these islands regarding this and other kindred departments of rural matters.

Cradled thus in its infancy among the literati and philosophy of classic Greece and Rome, extolled in praise by bard, philosopher, and historian—the greatest writers of that golden age of early literature,—need we wonder that arboriculture, and a practical love for trees and shrubs, flourished and grew apace in that distant era of the world's history? Nor were the nostrums and principles of rural economy and tree culture simply confined to the writings and theories of these grand old masters of style and rhetoric, for many of them wrote and spoke from intimate personal acquaintance in a practical form with the subjects they described, and whose praises

* Virgil, Geor. ii. 269. Col. de Arbor., 17, 4.

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they sung. They were themselves practical arboriculturists, and in their villas and suburban domains they gathered together choice collections of many of the novelties of their day, quite as eagerly as we now-a-days draw into intimate fellowship, in one shrubbery or plantation, the newest acquisitions sent to us by collectors from various and wide-spread climes and habitats. The cause of arboriculture, however, notwithstanding such favourable circumstances, in these classic times, and afterwards for centuries, did not flow on in a prosperous, unchequered tide of continuous development, for the constant thirst for conquest which prevailed in the aggrandising mind of the Roman not only diverted his attention away from peaceful occupations, but tended to foster animosities, and to carry destruction of forests and waste of lands into the territories of the savage inhabitants of these islands. And the progress of conquest led to extensive and widespread devastation of much of the forest land in them. For as the woods were convenient refuges for the natives when attacked, and from whose shelter they might harass and annoy the invading army, retreating again to their cover when retribution was likely to follow, the Romans naturally cut down and destroyed many of the forests; and the same policy was, for similar reasons, adopted by the Saxons and Normans during the periods of their occupation of Britain. Thus we find at the present day, occasional traces of plantations having existed upon hill sides and lofty elevations where now no tree is to be found, and the destruction of which may be traced to the times we refer to. So then it came to pass that, after centuries of denudation, it became absolutely necessary, for many reasons, to plant young woods to replace the old trees which had been destroyed; and from the particular kinds or species of trees so replanted, we may decipher much of the habits, necessities, and modes of life of our mediæval forefathers. The "Saxon Chronicle," remarkable as it is for the minuteness of detail with which it narrates many of the doings and customs of that period, tells us how the Conqueror, not finding land sufficient for his pursuit of sport, cleared "the New Forest" and certain other districts with a high hand. "He planted a great preserve for deer, and he laid down laws therewith."* We also find forest laws marked out, and exacted with great stringency. Charters of the Forest, as they were called, were passed or granted, and thus, probably unintentionally, by the high-handed arrogance and prerogative of the Norman monarch and his successors, the wooded

* Saxon Chronicle, 1087.

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lands of our country were saved from the ravages which would otherwise have befallen them in these troublous times.

As civilisation progressed, and the inhabitancy of the country in later ages became removed from the savage wigwam of the woods, or fortresses of the hill tops, or "*duns*," as they were called, to the baron's castle or feudal keep, generally built upon sites surrounded by cultivated land and in alluvial soils in valleys and plains, the necessity for planting timber trees for shelter became a matter of considerable moment, and thus the arboriculture of the early middle ages found an outlet for its development. The requirements, also, of these warlike times for spear-shafts and bows and arrows, and other implements of attack or defence, led to the practice of selecting and planting in convenient situations particular species of trees suited to such purposes. Hence we find the English yew constantly growing beside old castle ruins and dismantled forts, and in old churchyards; not placed in this latter situation, be it remembered, from respect to the dead, as is often supposed, or out of any idea that the gloomy and sombre shade of the yew was more suitable for a grave, than the bright rays of the sun falling upon it, but because the yew tree made the best bows for the archers, and consequently supplies of them were raised by the barons for their numerous retainers, and they were also grown by the monks in the churchyards and abbey lands for the use of their vassals. Thus, also, the ash tree is frequently found growing beside old castle walls, for its timber was also used for warlike purposes, and for the more peaceful requirements of the agricultural serfs, being used to supply the handles or shafts of the lances and pikes, and for the wooden portions of nearly all implements of husbandry. For domestic uses, the beech received much attention in early cultivation, being largely used in the manufacture of common domestic utensils; while the oak was indispensably necessary for centuries for the building of those "wooden walls of old England," which, long before the days of "ironclads," were all the country had to depend upon as a defence from invasion or attack.

While we thus see, from the remains of old forests and plantations of feudal times, some of the varieties of timber trees to whose culture more special attention was given in these early times; we catch more of the details of the principles of planting and rearing trees and shrubs, from an insight into the religious houses and monastic foundations of the thirteenth to the sixteenth centuries, through many of their chartularies and records still preserved.

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Whether their arboriculture was of a scientific kind or not, it is certain that, like the agriculture of the period under the supervision of the monks, it was systematic, and under strict regulation. The old Granges, which were the chief houses of each of the abbey baronies, were usually surrounded by plantations tastefully arranged; and it is to the early monks, and their frequent pilgrimages to the East and to continental shrines and countries, that we owe the introduction and acclimatisation in Britain of many species of trees, and shrubs, and plants now common amongst us. It may be noticed, as a type of civilisation developing itself in Scotland, and existing already in no mean degree, that we read "that in the chamberlain's books there is a charge for a gardener at the king's castle at Forfar;" * and in a document of the year 1261, one pleads a right to a garden in Morayshire, whence pot-herbs were to be supplied for the king's table when he dwelt in the castle of Elgin. Forty-two years later, when King Edward was in possession of Scotland, the Dean of Elgin beseeches him for a grant of oak-wood from a neighbouring forest, that he may rebuild certain houses and the enclosure of his garden, destroyed by the conquering army.† Early in the War of Independence there is a claim for damage by the English army on the estates of the nunnery of Coldstream, and of this, one item is for the "*pomer*" or orchard, which yielded the value of a hundred shillings annually beyond the fruit consumed by the house.‡ The enlightened attention and evident interest in all *agricultural* affairs that mark the era of the monastic institutions, from the reign of David I. and for centuries afterwards, spread by degrees from the monastery to the entire population during that peaceful monarch's reign and benign government; and as it is an axiom true of every country and people, that for "agriculture to succeed, arboriculture must precede," so we may safely infer that the art of tree growing, propagation, and planting was in an advanced state in our country in those interesting and early ages. Doubtless, in common with agriculture and other subjects which interested their material prosperity and comforts, the monks of the middle ages compiled and wrote treatises on arboricultural subjects. Unless they had done so, it is impossible to account for the progressive strides made in the culture of trees in their time, and these writings formed probably the earliest written literature of the science.

* Innes' Scotland in the Middle Ages, p. 124.
† Documents illustrative of Scotland, ii. 451.
‡ Hill Burton's History of Scotland, vol. ii. p. 109.

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After the discovery of the art of printing in 1438, and its introduction into this country about the year 1471, we are able to trace the development of arboricultural study in Scotland, and notice the attention which was paid to it as a great and important branch of rural economy. While many of the earliest printed books upon miscellaneous subjects refer to topics concerning the growth and planting of trees, &c., one of the first volumes wholly dedicated to the treatment of vegetable economy in its different departments is an old folio, written by an apothecary of London, one John Parkinson, who, in 1629, published his "*Paradisi in Sole Paradisus Terrestris*," which professed to be "A garden of all sorts of pleasant flowers which our English ayre will permit to be noursed up, with a kitchen garden of all manner of herbes, rootes, and fruites for meate or sause used with us, and an orchard of all sortes of fruit-bearing trees and shrubes fit for our land, together with the right ordering, planting, and preserving of them, and their uses and vertues."

In this early botanical work are given full and accurate descriptions of all the various plants mentioned, with their modes of growth, uses, and treatment; and the volume is full of quaint, but very accurate, woodcuts of many of the things described, illustrating the roots, foliage, flowers, &c. The volume is, however, more horticultural than arboricultural, properly speaking. In 1664 was published what may be styled the first standard printed work upon arboriculture. Evelyn's Sylva* is so well-known at the present day, and is still so widely read and admired, that anything like an attempt to describe it in detail, its principles or arguments, seems quite superfluous. The work of a man, an enthusiast in tree-culture, it has survived the wreck of similar works through centuries, and is still an ornament and authority in the libraries of all interested in trees. Like the works of the classical authors, Horace, Virgil, Cæsar, or Livy, Evelyn is turned to in many a quiet country home at the present day, not only to beguile the passing hour, but for improvement and instruction. The earliest edition of this popular book was, we have said, published in 1664; and there have been repeated and frequent republications of it. It was the first book printed by order of the Royal Society, the Sylva having appeared in 1664, while the Terra was not issued till 1675. The fifth edition, in 2 vols. quarto, with plates, was published so recently as 1825, edited with notes by Dr A. Hunter; and in this learned and accurate edition,

* Evelyn, John—"Sylva and Terra," or "Sylva, Pomona," also "Kalendarium Hortense." London, 1664, folio.

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the work has received many improvements; but its own intrinsic merit is shown by its popularity during nearly two hundred years. Professing to be a discourse on forest trees, and the propagation of timber in Britain, in reply to certain queries propounded to the Royal Society by the Honourable the principal Officers and Commissioners of the Navy, at a time when the necessity for an adequate supply of oak and other timber for such national purposes was of the very highest importance, the treatise of Evelyn was admirably calculated to meet the requirements of the case, and to stimulate any flagging zeal in the pursuit of practical arboriculture in the land. Living, as Evelyn did, to a good old age, with a singleness of eye and purpose for the good of mankind, his motto and aim seemed to be, in the words of Tacitus—"*Ad utilitatem vitæ omnia facta consiliaque nostra sunt diregenda;*" and in doing so it appears to have been to him rather a relaxation and amusement than an imposed task, so deeply did he love trees and the pursuit of natural knowledge. To the publication of this work, and to the royal patronage extended to it in a very gracious degree by the reigning monarch, King Charles II., we are indebted for many millions of timber trees, chiefly oaks, "besides infinite others," propagated and planted throughout England, and the royal example of cultivating "decaying woods," besides forming new forests, was productive of the highest benefit to the cause of arboriculture.

Evelyn's "address to the reader" shows well the spirit that animated his work, and the good he desired—the publication of it to extend over the length and breadth of the land. He desired to address himself to his "*better-natured countrymen*," "that such woods as do yet remain entire might be carefully preserved, and such as are destroyed sedulously repaired. It is what all persons who are owners of land may contribute to, and with infinite delight as well as profit, who are touched with that laudable ambition of imitating their illustrious ancestors, and of worthily serving their generation. To these, my earnest and humble advice should be, that at their first coming to their estates, and as soon as they get children, they would seriously think of this work of propagation also, for I observe there is no part of husbandry which men commonly more fail in, neglect, and have cause to repent of, than that they did not begin planting betimes, without which they can expect neither fruit, ornament, or delight from their labours. Men seldom plant trees till they begin to be wise, that is, till they grow old, and find by experience the prudence and necessity of it. When Ulysses,

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after a ten years' absence, was returned from Troy, and coming home found his aged father in the field planting of trees, he asked him 'why, being now so far advanced in years, he would put himself to the fatigue and labour of planting that of which he was never likely to enjoy the fruit?' The good old man, taking him for a stranger, gently replied, 'I plant against my son, Ulysses, comes home.' The application is obvious, and instructive for both old and young."*

Nor did Evelyn insist upon promiscuous planting, and by unskilled labour. He warned young planters against "committing themselves to the dictates of their ignorant hinds and servants," "who are," says he, "generally speaking, more fit to learn than to instruct." Would that his advice were still adopted and inculcated at the present day, when ignorant labourers, destitute of any knowledge of the forester's art, are too often entrusted with important operations, when a skilful knowledge of the physiological principles of vegetable life and tree economy are superlatively requisite and indispensable to future success.

No easy or insipid study did Evelyn discourse upon, but he continually throughout this very important book dignified the business of planting into an art or science, and recommended its prosecution in such a spirit. His work gives a detailed account of each timber tree, its uses, habits, cultivation, adaptability to different soil, situations and purposes, modes of propagation, and botanical description of each are appended. The illustrations in the later editions of the book are excellently rendered, and altogether Evelyn's work may be ranked as the earliest pioneer of the study of arboriculture, whose deeds and teachings have left an indelible impress upon the whole country. His work is the best early standard authority upon planting and treatment of trees; and although, as he himself in his preface admits, it is not written "for the use of mere foresters and woodmen, but for the benefit and diversion of gentlemen and persons of quality, who often refresh themselves in these agreeable toils of planting and gardening," still, his style and matter are such that the work cannot fail, at the present time, to be very intelligible and appreciable to the intellect of the improved status of foresters of our day of advanced civilisation and knowledge. Appended to the Sylva is "an historical account of the sacredness and use of standing groves," showing in eloquent terms in what estimation old trees were held for their divine as well as for their civil uses.

* Evelyn's Sylva, edit. Hunter, 1825, vol. i. p. 32.

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In 1675, we find the next work of importance published in an octavo volume of much curious information by the gardener to the Earl of Essex, Moses Cook by name. He styled his book "The Manual of Raising, Ordering, and Improving Forest Trees." In this interesting relic of bygone times are given, with great clearness and precision, directions how to plant, make, and keep woods, walks, avenues, lawns, hedges, &c.; and there are also given rules and tables showing how the forester may acquire the art of measuring superficial figures, divide woods or lands, and measure timber. This quaint old gardener remarks, that "it has been and is observed that those who are wasters and wilful spoilers of trees and plants, without just reason so to do, have seldom prospered in this world." He carefully inculcates upon his readers the due conservation of trees, narrating those specially useful for different purposes in planting; and he proceeds to warn his readers against many of the "*rocks*" or errors then prevalent both in regard to sowing, grafting, "watering with coloured water," "boring holes in trees, and putting honey or other sweet things into them, to make them bear more and sweeter fruits," or believing "that the sap of trees at the approach of winter falleth from the head into the root." Rules are laid down for pruning forest trees, and all the arguments used by Cook are derived from his own personal observations and experience of actual results arising from the various modes of treatment he adopted. This worthy father of the planting art strongly urges the proper preparation of the ground intended for plantations. "*A thing once well done is twice done*," says he; so those about to plant are advised "not to bury their plants in a hole like a dead dog, as too many do," but to give them "good and fresh lodgings suitable to their quality, and good attendance also, to preserve them from their enemies till they be able to encounter with them; they that will not do this, let them never resolve to plant trees." His descriptions of the various modes of procedure in sowing and planting the different varieties of forest trees are thoroughly practical, and the book is altogether a complete hand-book of the time in which it was written, and by one who has evidently been an enthusiast in his profession, and under the supervision of an employer who was no less skilled in tree-culture, and such kindred subjects, than the author was himself, and from whom, probably, Cook derived many of the hints given in the volume. He had evidently read and studied Evelyn, published eleven years previously, in whose praises he is loud, and whose theories he unreservedly endorses.

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In 1677, appeared an elaborate folio from the pen of one John Johnston, "Medical Doctor," entitled "Historia Naturalis de Arboribus," in ten books. This work is, however, devoted more to fruit culture than to a descriptive narrative of tree-growing. Its illustrations, contained in a separate folio of 137 plates, are most accurately and beautifully engraved in copperplate, and contain examples of sections of stem, leaves, fruit, seeds, mostly life-size, with the botanical names attached. But although the major part of the work is devoted to pomological subjects, attention is also given to dendrological; and shrubs, heaths, and flowers are also delineated. This book cannot, however, be regarded as any authority at the present time, or as having attracted much attention even in its own time. It is rather a reflex of the view held of such objects as subjects of illustration to botanical students of the time.

In 1724, was published a translation, by John James of Greenwich, of a French work published in Paris in 1720 by Le Blond, styled "The Theory and Practice of Gardening." It is a quarto volume, and the subject matter is divided into four parts. This book may be called the book of the garden of that period, and like more modern treatises, it enlarges upon laying out and adorning of grounds, pleasure walks, and gardens, giving detailed plans and drawings of the designs recommended. The third part of the volume, however, on account of which alone it is noticeable in this paper, is devoted to the choice of trees and their treatment in policy and ornamental plantations. Le Blond describes with much minuteness the methods of planting, the care to be taken of the young plants, and their protection from insects and vermin; the treatment of nurseries, and of flowering shrubs. He also discourses of hedges, and planting them, and of many other objects in use for ornamental effect in and around country residences. While the book is written more especially for the better climate of France and south of England, there are many useful hints equally adapted to profit and instruct planters and those engaged in laying out ornamental plantations in our own more northern latitude. The book became an authority in its time and for long afterwards, although, owing to the unfortunate rebellions and civil wars with which this country was shortly afterwards visited, little attention was then given for fully half a century to such peaceful arts as those of arboriculture.

We now approach a blank chapter in the history of the literature

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of arboriculture, and it is not until about the years 1780–90 that public attention found leisure to devote itself to the development of rural economy and the peaceful improvement of agriculture and arboriculture. No doubt, in 1765 the "Scots Gardener" appeared, a small quarto volume of much curious and interesting matter. It related chiefly to subjects and operations suited to the climate of Scotland, and embodied with it the Earl of Haddington's treatise on forest trees. This volume was written and compiled by J. Reid, gardener to Sir G. Mackenzie of Rosehaugh, and was dedicated to the "Ingenious planter in Scotland." We thus see that, despite civil commotion, the minds of the practical men of the country were being fully awakened to the necessity for more careful attention to arboricultural studies, and to more extensive planting of woodlands. Indeed, about this period—1770–1775—a strong current set in, in favour of a general improvement of Scotland, and of a more extensive system of planting, upon what might be styled an almost national scale. This full tide of public feeling and desire gained its height in 1784, when the Highland Society of Scotland was founded. The incorporation of such a Society naturally led to a direct advance in all rural matters. The steady progress in agricultural affairs, which had been quietly making its way amongst the tenantry of Scotland, suddenly received an incalculable impulse; and as by the auspices of the new Society it became necessary to shelter and secure climate for some of the land placed under cultivation, planting became requisite in the first place for shelter, and this led to the adoption of forests and woods, and of arboricultural subjects under the auspices of the Highland Society. The encouragement given by the Society to planters (whether proprietors or tenants), naturally led to increase the popularity of the Society; and the premiums subsequently offered for such arboricultural subjects as were specified for the year, tended greatly to an enhanced knowledge of tree-culture being manifested and followed among practical arboriculturists in Scotland. Indeed, the prize essays of the Highland Society upon arboricultural subjects may be considered as one of the chief features in the literature of Scottish arboriculture for many long years, and down even to the present day. The advantages acquired from the intercourse and mutual interchange of opinions with practical men, rendered necessary for writers of monographs for this Society, have led to the notice of many curious and singular phenomena in tree-life and its development under peculiar circumstances, which would probably, but for

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the auspices of such an association, never have been observed. The dissemination of such views and opinions throughout the country, and especially amongst landed proprietors and their tenants and foresters, has been productive of the highest good. The general views of the agriculture of the various Scottish counties, with observations on the means for its improvement, drawn up by eminent and reliable local reporters for the "Board of Agriculture and Internal Improvements," which had been organised about this period, were of themselves also another considerable impetus to forestry, inasmuch as land destined for reclamation and improvement, or reported upon for amelioration, necessitated in many districts more extensive planting, and attention to permanent enclosures of woodlands already existing. Although more an agriculturist than an arboriculturist, the proprietors of Scotland at the present day, and society at large, are under a deep debt of gratitude to Sir John Sinclair, the eminent founder of the Board of Agriculture, whose unwearied energy, continued during a long and useful career (one of his latest works* being revised by his own hand, in his 80th year), induced and stimulated others to forward the cause of progress and rural improvement throughout the length and breadth of the land, and to elevate agriculture, and other cognate industrial rural pursuits, from mere mechanical arts to the dignity of a science.

Along with these dawning rays of better days for arboricultural knowledge throughout Scotland, and as might naturally have been expected from the improved state of matters thus happily inaugurated, a whole shoal of authors poured their flood of ideas to swell the tide of enhanced and improved arboricultural literature. About this period (the beginning of the nineteenth century), the number of works which appeared upon tree-culture, and such kindred subjects, was quite unprecedented; and it would occupy more space than we can afford in this cursory sketch, even to notice these productions in anything like the manner which their merits deserve. It must suffice that the names only of a few of the more noticeable books upon arboricultural subjects are given in this paper. To review the matter contained in them would swell this essay into a very considerable volume. We have, first of all, the various admirable works of Gilpin, whose classical taste and skill in landscape effect are well known; and in several places at the present day his treatment of the subject is quite apparent in the harmony and pleasing effect produced by his labours. His essays on Picturesque Sub-

* Code of Agriculture, 5th ed. 1832.

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jects,* his "Forest Scenery,"† and other works, are still standards of classical writing, purity of taste, and cultured ideas, and are as such worthy of reference for the planter or landscape gardener, no less than for the practical arboriculturist.

In 1800, Wm. Pontey published his "Profitable Planter,"‡ a treatise on the theory and practice of planting forest trees. It appeared in 1 vol. 8vo, and met a ready sale. The thorough practical knowledge of its author, narrated in plain language in every page, gave this volume what many others about this time much lacked—an impression of earnestness and complete fitness to inculcate useful teaching, which unfortunately many of the volumes appearing about this period sadly wanted. It was really, as he styled the book, as "*The Profitable Planter*," that he desired to appear before the public; and his whole volume teems with interest, and with an evident strong wish to teach others how to make the most of their trees and plantations, and how to plant with prospective benefit in a pecuniary view. About the same time, or a few years later, Mr Pontey published his "Forest Pruner,"§ which was destined to initiate the young forester into the art of pruning and treating physiologically timber trees. How he succeeded is best narrated by the fact that this book ran through several editions; and Mr Pontey himself long occupied the responsible office of "*forest pruner*" to two Dukes of Bedford. In publishing these works Mr Pontey disclaims all idea of writing with a view "*to sell*," but that his views and principles might become "*extensively useful*."

But along with the appearance of those works upon arboricultural subjects just now cursorily noticed, there were others about the same time published, and all of more or less value, in so far as they touched upon the various phases or points of the art or science of tree culture, then so rapidly developing itself. We have thus, Marshall on "Planting and Rural Ornament," a standard work of the time, in 2 vols. 8vo, published in 1803. This, as it professed to be, was really a "*practical treatise*," and narrated in detail planting operations, descriptive notices of hedges and hedgerow timbers, seasons for planting, defending newly-planted trees, underwood management, timber groves, coppice, and modes of filling up wooded wastes, with details of the duties of foresters, &c. His second volume is devoted to

* Three Essays on Picturesque Beauty and Landscape, &c. W. Gilpin. 3d ed. 1808.

† Remarks on Forest Scenery, by W. Gilpin. 2 vols. 8vo. 1796.

‡ Pontey, W.—The Profitable Planter. 8vo, 1800.

§ Pontey, W.—The Forest Pruner. 8vo, 1806.

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botanical descriptions, classical arrangement, and an index of English names, and an alphabet of plants. This is altogether a work of much merit, and well worthy, even at the present date, of the attention of young foresters. Besides these, we have Cruickshanks' "Practical Planter;"* Monteath's "Foresters' Guide;"† and also the works of Nichol, Sang, Billington, and various others, in each of which the usual operations of planting, thinning, transplanting, pruning, &c., form the prominent features, together with the treatment of planting waste lands, measurement of timber, and disposal of felled wood, bark, and other forest produce.

But while most of the works upon arboriculture about this period (1800–1830) were chiefly devoted to the principles that should guide the general operations of planting, one work appeared whose attention was wholly directed to an especial branch in the treatment of trees, namely, the transplanting of large trees for immediate effect. "*The Art of creating Landscape Effect,*" or "*of giving immediate effect to wood on scientific principles,*"‡ as Sir Henry Steuart styled his "Planters' Guide," is a volume of much merit, of purely classical style and feeling, and contains many useful hints for those who choose to adopt this method of making haste to be rich in ancestral timber trees. He certainly did more than any other man then living to carry out the idea of removing large timber to other sites for effect and utility, whether of ornament or shelter, and he succeeded. His book is an admirable account of his modes of procedure, and worthy the attention of all at the present day who meditate the creation of landscape effect. Sir Henry Steuart's love of trees led him to do much to obtain them for immediate effect, but whether the cost of doing so, compared with the cost of planting young trees in favourable situations among nurses, is surpassed by the process adopted for immediate effect, the reader of Sir Henry's book must judge for himself. The old Scotch proverb, that "*the cost o'ergangs the profit,*" may perhaps be found true in this instance, if any ardent enthusiast in tree-lifting should try the experiment upon an extensive scale. Sir H. Steuart, however, deserves much credit for his indomitable exertions in this behalf, and for his having so well achieved what he so laboriously undertook.

While thus the patient labours of literature and careful observation and study were doing their utmost for arboriculture, the following table of the dates of introduction of many new species of trees

* Cruickshank, Thos.—Practical Planter. 8vo, 1830.

† Monteath, R.—Forester's Guide and Profitable Planter. 2d ed. 8vo, 1824.

‡ Steuart, Sir H.—The Planters' Guide. 8vo, 1827.

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into Britain will show that practical men were no less forward in their attempts to stimulate and advance the cause of tree-culture and the improvement of timber growing in this country, by adding to the already acclimatised varieties such others as seemed suited to the climate of Britain, and which have since become well known and established denizens of our woods and pineta :—

Pinus Cembra,	introduced	1746.
P. Laricio,	„	1759.
P. pumilio,	„	1779.
P. Pallasiana,	„	1790.
P. calabrica, P. canariensis,	„ „	1823.
P. austriaca, P. pyreniaca,	„ „	1835.
Picea cephalonica,	„	1824.
Pinus Pinsapo,	„	1839.

Prior to that period there had been added to the flora of the British woodlands many varieties from the seaboard of North America, about the beginning of the eighteenth century, and from India early in the nineteenth century, viz. :—

Abies alba, ,, nigra,	introduced about	1700
Pinus Strobus,	„	1705
P. Tæda,	„	1713
Banksian Pine,	„	1735
Pinus (Abies) canadensis,	„	1736
P. inops,	„	1739
P. mitis,	„	1739
American Larch,	„	1739
Pinus serotina,	„	1740
P. pungens,	„	1742
Red Spruce,	„	1754
Pinus resinosa,	introduced about	1755
P. rigida,	„	1758
Araucaria excelsa,	„	1793
Pinus longifolia,	„	1801
Abies Smithiana,	from India	1818
Picea Pichta	from India	1820
Pinus Gerardiana,	from India	1822
Picea Webbiana,	from India	1822
Pinus excelsa,	from India	1827
Cedrus Deodara,	from India	1832
Picea Pindrow,	from India	1837
Abies Brunoniana,	from India	1838

Among the more remarkable of the Californian species, the following varieties had been introduced during this era of activity in arboricultural literature down to the present day :—

Pinus ponderosa,	introduced in	1826
Abies Douglasii,	„	1826
Pinus tuberculata,	„	1825
Pinus monticola,	„	1826
P. muricata,	„	1827
P. Lambertiana,	„	1827
Picea grandis, ,, amabilis, ,, nobilis,	„	1830
Abies Menziesii,	introduced in	1831
Picea bracteata,	„	1832
Pinus Coulteri,	„	1832
P. Sabiniana,	„	1832
P. insignis,	„	1834
Taxodium sempervirens, (but known in 1796).	„	1840
Wellingtonia gigantea,	„	1853
Cupressus Lawsoniana,	„	1854

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These dates sufficiently prove the zeal which had been awakened in arboricultural matters, and the interest which planters in this country were evincing in the matter. The avidity with which, during the latter part of the eighteenth and the early part of the nineteenth century, arboriculturists ransacked foreign climes for new and rare species of *hardy* timber trees was fairly appeased, but only so to burst out afresh in new channels, with fresh longings and aspirations after new acquisitions.

About this time appeared Loudon's great work, the "Arboretum et Fruticetum Britannicum," one of the most stupendous undertakings in book history which has ever been achieved. This unparalleled testimony to indomitable perseverance and application which has ever been published, either in ancient or modern times, first appeared in 1838, and in a few years ran through several editions. It originally came out in numbers; and as all the trees which were figured in its pages were drawn from nature, they were published as they could be obtained, blanks being left for those of which good specimens could not be found. This doubtless led to some confusion, and inaccuracies in the plates arose from different names being given to the same plant, and only one tree was thus sometimes found to fill two spaces. In later editions this was rectified. The "Arboretum Britannicum" amply fulfilled the intentions and professions of its illustrious author, and may be briefly styled or described as an accurate and full record of all the trees and shrubs of Great Britain, whether these were indigenous or foreign; it correctly defines their hardihood, and suitability of constitution in that respect to the climate and situation of soil and otherwise; they are described in the most popular manner, and yet are scientifically treated at the same time, so that the systematic botanist, no less than the mere amateur in tree knowledge, can peruse Loudon's work with pleasure and satisfaction. The propagation, culture, and management of each species are carefully given, and the uses of the various trees or shrubs, whether in commerce or as useful for ornament or shelter, minutely described. The genus and species are delineated according to the Natural Orders; and one of the not least interesting divisions of this great work is the very complete historical and geographical vidimus given of the trees and shrubs throughout the temperate climates of the world, as known at the time the author wrote. This most comprehensive work, in itself a living monument to the patience, industry, and accuracy of an eminent botanist, occupies no less than eight thick octavo volumes—four of letterpress, illustrated by upwards

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of 2500 woodcuts, and the other four being composed entirely of octavo and quarto plates of reference. Some general idea may be formed of the great labour and research undertaken by Loudon in the preparation of this magnificent work, when it is stated that the list of books of reference to which he had recourse in the preparation of the Arboretum, and which he truthfully gives as showing his different authorities, occupies no fewer than thirty-seven closely printed and small-type pages of the first volume!

Other important works upon arboricultural subjects, and filling conspicuous niches in its literature in the earlier years of the nineteenth century might be named, such as the Hortus Kewensis, Miller's Dictionary, in which are rendered, along with portraits of the plants themselves, the names of their first introducers. The magnificent "Salictum Woburnense," and the no less interesting treatises of Cook and Hanbury, originally published contemporary with the earlier editions of Evelyn's Sylva, were still regarded as authentic even about the close of the eighteenth century.

Coming down to more recent times, we find in 1842 the issue of a book bearing the traces of careful study of trees and their management, in Selby's "History of British Forest Trees." This work, beautifully illustrated with steel engravings, is still an acquisition to any library where the collection of works on trees is desired to be complete. The monographs and critical notices of the various species are well and carefully digested, and contain many interesting particulars. The writer proceeds a good deal upon the style and manner of Evelyn, but his facts are more modern, and the book is more a handbook to the knowledge of the various trees than the more elaborate work of Evelyn.

In later years the attention of arboriculturists seems to have been directed more particularly to specific branches of the science; and, indeed, as it became more a study, and the treatment of trees came to be considered more with regard to the physiological laws of nature, and in accordance with these, it is natural to suppose that such subjects as pruning, transplanting, felling, draining, enclosing plantations, and diseases of trees, &c., would form material for many different exponents, giving to the world their views in their own specific department. Hence, we find such works as M'Intosh on the Larch Disease,* the Tree-Lifter by Colonel Greenwood,† Köllar on the insects which

* M'Intosh, C.—On Larch Disease. Fcp. 8vo.

† The Tree-Lifter, by Col. W. Greenwood. 8vo, 1844.

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affect Forest Trees,* arresting public attention, and directing foresters and others interested in tree growth to the correctness or fallacy of their special views.

Again, we have "*the pine mania*," as it has been called, affecting enthusiastic tree growers, for whose special benefit, volume after volume and paper after paper upon the Coniferæ issue from the press. These have chiefly been printed since 1850. Thus we have the able standard work upon Conifers by Gordon,† with its valuable and indispensable supplement, ‡ giving the synonymous names of the different pines of more recent introduction, with botanical nomenclature and descriptions, and other interesting details as to their hardihood, habitats, &c. Messrs Noble and Standish add another useful and valuable little handbook of these newer members of the flora of our ornamental woods, in their treatise on Evergreen Trees and Shrubs; while it is impossible to overlook the great undertaking of the late firm of Messrs Lawson in their truly magnificent fragment, viz., "Pinetum Britannicum," published in upwards of 30 parts hitherto, and the continuation and completion of which it is to be sincerely hoped is only delayed, not abandoned. Of the more recent introduction of the Japanese pines, we find in 1863 our esteemed fellow-labourer in the cause of arboriculture, Mr Andrew Murray, contributing his quota to the literature of the science in his "Firs of Japan," a useful and instructive guide to those planters who may be adding these newer varieties to their pineta. Nor would it be right to omit to mention here without a passing tribute of esteem the labours and writings of Mr Fortune, the pioneer of discovery and conquest from the Chinese and Japanese flora; for he has individually done more to enrich our gardens and pleasure grounds with treasures from the distant East, as well as from other remote climes, than any other man living; and while thus actively engaged in adding to the store of material wealth of our collections, his pen has been no less able and successful in giving us clear and interesting descriptions of the countries whence his captives were brought, and histories of the treatment and uses of these plants in their native habitats, of the highest value to us in their acclimatisation in this country.

Grouped together as interesting and instructive volumes for the training up of youthful minds to a right appreciation of and interest

* Köllar on Insects which affect Forest Trees. Fcp. 8vo, 1840.

† The Pinetum, Gordon and Glendinning. 8vo, 1858.

‡ Supplement to The Pinetum, Gordon and Glendinning. 8vo, 1862.

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in the love of trees, we may mention here "English Forests and Forest Trees," 8vo, 1853, published under the sanction of the Society for Promoting Useful Knowledge. In this book an historical account is given of all the old English forests, from the times of the Druids, with their traditions, laws, and customs, and with individual trees described, and their historical associations referred to. "Trees and their Nature," by A. Harvey, M.D., published in 1856, is another valuable and instructive book for the young forester or boyish student of trees. The information, botanical, historical, and physiological, &c., is given in a pleasant, gossiping style, in the form of a series of letters from a father to his sons. "Forest Trees of Britain," by Rev. C. A. Johns, 8vo, and "British Forest Trees," 2 vols. 8vo, both issued by the Society for Promoting Christian Knowledge, are useful and entertaining for the general reader, or for the young forester's fireside of a long winter's evening.

Amongst the more modern works upon the subject of arboriculture generally, or upon the details of work of the practical forester, we must refer to three, as being each in its own line eminently calculated to meet the special requirements which its publication was intended to supply. These are "The Forester," by J. Brown, LL.D., Stirling, whose practical skill in the Arniston woods enables him to speak with the wisdom of experience upon all the various duties of the forester in their many forms, while his descriptions of the various species of trees are accurate and concisely given. A recent edition of this valuable work brings the information down to the present day, and embraces notices of the more recently introduced Coniferæ in Scotland and England. The second volume, to which we have referred, is "Grigor's Arboriculture," 8vo, 1866. This is also an eminently practical work, and is compiled chiefly from the successful papers which the author had contributed from time to time to the Transactions of the Highland and Agricultural Society. It is a book well worthy the careful perusal of all foresters, and it might be advantageous to the proprietors of large estates to place a copy in the bothies of their foresters and woodsmen, while its perusal and attentive study will qualify an intelligent young man for almost any department of practical forestry or planting. The third volume alluded to, and the most recent addition to the literature of arboriculture in this country is "Forest Trees for English Climate," by A. Montgredien. This beautiful volume contains a valuable catalogue of the different trees of recent introduction, showing their progress and hardihood in this country,

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with a carefully adjusted list of places where good collections exist. Several chapters are given upon the special adaptation of trees in this country for town culture, for foliage, for form of outline, grouping, or for planting in single line or solitary position. It is an admirable work and well written, but is certainly more adapted for the proprietor's library table than for the use and instruction of the practical forester.

A more recent work still than that of Mr Montgredien, is the octavo volume published last year by Messrs Longman, entitled "Hand-book of Hardy Trees, Shrubs, and Herbaceous Plants," by W. B. Hemsley (late of Kew Herbarium). This work is based upon the French production of Messrs Decaisne and Naudin, and deals largely with technicalities of detailed descriptions, nomenclature, &c. It contains a very full and complete glossary of terms in botany and plant economy. It gives the generic names, with their derivations in detail, for the benefit of such as have not a ready knowledge of Greek or Latin; and it gives very full descriptions, with the native countries and habitats, of the trees referred to, and adds general remarks upon the hardiness and comparative suitability of each to different situations and circumstances. The notice of herbaceous plants and flowers gives the work more a general botanical aspect than a merely arboricultural work requires, but still we are justified in awarding it a place in the literature of arboriculture from the value of the remarks and classifications, &c., allotted in it to tree culture, and the general excellence of the entire book. Its only fault appears to be that too much space is prominently given to some genera to the exclusion of some remarks that might have been made upon others. The nomenclature of Coniferæ, as in many other works at the present day, is sadly confusing and unsatisfactory.

The volume upon Old and Remarkable Trees,* edited under the superintendence of Mr W. Thomson (late of Dalkeith), gives a very fair and complete list of the largest trees throughout the country, specifying their girths, dimensions, soil, situation, and exposure, grouped into counties, and the different species of trees classified accordingly, with a letterpress description of the genus. But while this volume, as a record of what is old and remarkable, is good so far as it goes, there is much yet to be done in this particular branch of the literature of arboriculture, and in collecting

* Old and Remarkable Trees in Scotland. Thomson, Ed. 8vo. A Highland Society publication.

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fuller statistics, for many of the best and largest monarchs of tree-growth in Scotland have been omitted.

But while much has been written, as will be seen from the foregoing cursory remarks, regarding the study of arboriculture in our own country, other nations have been increasing and perfecting their knowledge also of this engrossing subject. It would be impossible to enumerate the long list of works upon forestry published during the last two centuries in France, Hanover, Germany, Austria, and even in Italy of recent years. In these countries, the forest schools lend an immense impulse to the progress and development of such literature. But while thus passing over, with the mere mention of its existence, so important a feature in the world's history as the literature of arboriculture, we must not fail to refer to a volume upon a most important chapter of arboriculture, affecting the British Crown in a most material degree, namely, the arboriculture of the forests of our Indian Empire. So many young foresters from Scotland now go forth to seek their fortunes in the jungle and forest stretches of India, and in the Deodar-clad heights of the snow-peaked Himalaya, that it seems to us this paper would be incomplete in itself, and we should be wanting in respect to the services of one, of whom the Scottish Arboricultural Society should ever be proud as a worthy President, did we not notice Dr Cleghorn's excellent manual of the "Forests and Gardens of South India," published in 1861, and well worthy the careful and attentive perusal of any one proposing to join the forest staff of the Indian Government. In fact, it seems to be an indispensable handbook to such a life in India. We cannot close this somewhat discursive paper without reference to our own series of arboricultural papers, which ought to form, and probably, by and bye, will form the essence of the literature of Scottish arboriculture. This Society has now been in existence for twenty-one years, and during that long period, from a small and weakly nurseling, through a very chequered career, has now emerged into her full strong majority, with a constitution invigorated and strengthened during recent years. Throughout these two decades, and without one blank, this Society has published her small annual volume of Transactions, or prize essays of the year, upon prescribed subjects connected with arboriculture in its varied departments. We have therefore in the seven volumes of Transactions already published, the thoughts of practical men upon the different phases of tree-growth, and culture, and treatment. Crude and imperfect although these papers may often be, progress has

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been made, and improvement is visible as year by year rolls on; and we fondly hope, if indeed we may not believe and assert, that with such a phalanx of the flower of Scottish forestry—that cradle of the literature of the science in which some of her ablest and most practical writers and authors were reared in bygone years—the future is bright with expectation; and that so long as the members of this Society manfully and cheerfully hand in hand pull together as a united brotherhood in the interests of arboriculture, the literature of that important department of rural economy will not be allowed to become a thing of the past, nor the researches of any labourer in her cause be forgotten.

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XXV.—*On the Present State and Prospects of Arboriculture in Aberdeenshire.* By WILLIAM GILCHRIST, Forester, Cluny Castle.

Aberdeenshire is allowed to be one of the best wooded counties in the north of Scotland, and in some parts the work connected with the management and rearing of plantations, and the manufacture of wood, have been the chief industries of the people. The extent of ground under wood has been ascertained by detailed statements to be about 115,000 acres. The Board of Trade Returns for 1872 give it at 93,680 acres, but these returns may well be doubted, as, where so many parties are interested, it is almost impossible to procure accurate information.

West Aberdeenshire—or the district drained by the Dee and the Don, with their tributaries, is the principal wood-growing portion of the county. An old couplet says:—

> "The Dee for fish and tree;
> And the Don for corn and stone."

But at present, taking into consideration the amount of ground suitable for, or what could be most profitably used for the growth of trees, the basin of the Don, at least, the upper part of it, is fully equal to that of the Dee. The part of the basin of the Deveron in Aberdeenshire is also well wooded, the famous Binnhill (2600 acres), said to be the largest plantation within one ring in the county, being on the north bank.

Towards the end of last century the planting of wood on waste land was prosecuted vigorously, and had it been continued the income of some estates, where large tracts of suitable land still exist, would now have been considerably increased. The impetus, from some cause, did not continue long; but it was revived about thirty years ago, and at present the more extensive planting of the waste land is a practical problem to be solved before any great extent of it can be improved and kept in cultivation.

The introduction of water-power sawmills, and of portable engines with saw machinery, has developed the wood trade of the country considerably, and increased the sums obtained for rough wood. The high prices which for sometime have been realised from the sale of timber has forced proprietors to appreciate it as an important item in the income of an estate, so that much more waste land has

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been planted during the past few years than for a long period previously. Taking all this into consideration, and making due allowance for what may yet be planted, the probabilities are that the future arboriculture of Aberdeenshire will be better than the past. No doubt extensive tracts of waste land suitable for growing trees will still remain unoccupied; but in a large county it is impossible to get the proprietors all of one mind, even though the object aimed at be the clothing of our waste and barren hills with wood.

Valley of Dee.—About fifty years ago, Deeside was the best wooded portion of the county; but as a demand set in for home wood, and as the prices increased, the wood on Deeside was fully taken advantage of, and in some instances large revenues were for a time realised. In the districts of Aboyne, Glentanner, Balfour, Birse, Ballogie, Finzean, and the borders of the county near Banchory, large quantities of wood have been cut, and in some instances whole hillsides have been cleared. Parts of the famous Glentanner Forest have been replanted, but the greater proportion remains waste. The ground and situation is most suitable for the Scots fir; it has been the principal variety used, and is doing remarkably well. Larches also grow well, but they are not so numerous. Opposite Aboyne, on the south side of the river, an extensive tract of plantation has been formed recently, principally Scots fir, with a few larch and mixed hardwoods. The forest of Birse still remains unplanted, but portions of the hill ground adjoining have been planted, and, considering the exposure, are doing well, so that the district will in a few years have somewhat of its former appearance. Portions of the low ground, after being cleared of wood, have been reclaimed and made arable, but the greater part, especially about Ballogie and Aboyne has been replanted. Judging from the progress that the second crop of wood is making, it is generally allowed that a good deal of the ground recently made arable would have paid the proprietors as well under timber. In several young plantations about Ballogie the ordinary varieties of hard wood, as also some of the newer conifers, are growing luxuriantly. Near Aboyne Castle, specimen hardwood trees, oak, ash, elm, &c., are numerous in the parks and policies, as also old larch and Scots fir.

For some time large quantities of good wood, principally larch and Scots fir, have been cut in the Ballater district, but much still remains, especially about Birkhall, Abergeldie, and Balmoral, including the fine old wood of Ballochbuie. At Glenmuick most of the old wood has been cut, but contracts for planting on an exten-

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sive scale have been entered into and begun lately—25s. per acre being the price of plants and planting. As a rule, the planting at these places has not kept pace with the cutting, but at Balmoral some belts and clumps of mixed hardwood trees, as also some of the newer conifers, have been introduced, principally it is said at the instance of the late Prince Consort. These have been most judiciously arranged, and considering the district are doing remarkably well. Natural birch grows freely throughout this part of the district, but it can seldom be grown profitably.

At Invercauld large quantities of first-class wood have been recently cut, but a good deal of the ground thus cleared has been replanted, so that the arboricultural prospects of that district and of Upper Deeside may be said to be fully as good as the past. A large extent of ground has been planted on the right bank of the river, between Invercauld and Braemar, as also on the lower slopes of Benavon and Benabuird, but the extent is small when compared with the available waste land suitable for the growth of trees, and it is apparent that the banks of the upper part of the Dee are not nearly so well wooded as they ought to be, large tracts of land which would grow good Scots fir and larch, being occupied with natural birch, aspen, alder, rowan, &c.

The remains of old forests are still found in the district, conspicuous among these are Glen Derry, Glen Lui, and the remains of an old pine forest near the source of the Quoich, and farther down this glen both banks are well wooded with fine thriving Scots fir. In Glen Derry and Glen Lui little now remains except a few straggling trees and clumps of old Scots fir. It is said that a few years ago, when clearing out the dam of Derry, which was formerly used for floating timber, some fir logs were found bearing the date 1656. These logs when taken up were comparatively fresh and sound.

In the district between the Dee and the Don, including Cromar, Tarland, Kincardine O'Neil, Cluny, Midmar, Echt, and Skene, there is some very useful wood, principally larch and Scots fir. The larches are in general not very heavy, but they are good and useful. About Tarland and Cromar some good plantations, chiefly Scots fir and larch, may be seen at all stages of growth. These have been mostly formed during the last forty years, and are chiefly on the estates of Cromar, Tillipronie, Blelack, Melgum, Coldstone, &c. Some plantations in this district have been formed remarkably cheap; for instance, in 1862, the hill of Craigton, near Lumphanan,

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was planted for 11s. 6d. per acre, one-fifth of the plants being larch; and in 1867 the hill of Hilton was planted for 10s. per acre. Since that time prices have gradually increased, the same class of planting costing 30s. per acre at Glenmillan this year. The Learney woods are extensive compared with the extent of the property. A great deal has been cut there lately. On the Hill of Fare, which extends from Learney to Echt, including part of Crathes and Midmar, the larch is frequently covered with "moss" sometimes 8 or 10 inches in length,—and yet the wood does well and is of fair quality. The Scotch fir does not succeed so well on this hill, except on low grounds, but in some of the glens on the north side there are specimens of very large dimensions. The north-east, east and west sides of this hill are well wooded, but not the north and south sides, although they are in every way suitable for growing good wood.

A large portion of a long ridge of hill stretching almost from Deeside to Don, through the parishes of Kincardine O'Neil, Craigievar, Tough, Cluny, and Monymusk, has been recently planted by the several proprietors, especially on the south and east slopes. A large portion of this hill was planted by contract at from 18s. to 22s. per acre, and has been quite a success. The trees are principally larch and Scots fir, with spruce in the soft and mossy ground. Though planted at intervals during the last twenty years, the hill side begins to have a uniform appearance, so that the district will soon be considerably changed and the climate ameliorated. This tract of plantation is mostly virgin soil, having been planted in heather land. The greatest drawback to its growth is a moorband pan, which often occurs near the surface, the portions where it occurs most frequently have been partially drained, to counteract the pan if possible. Most of the plants are doing well and growing rapidly. In the Cluny district there are some splendid Scots fir plantations, the size of the trees and quality being second to none in the county, if we except the famed wood of Ballochbuie on Deeside. Larches are also large and of good quality, but not nearly so numerous as the former. The districts of Craigievar and Tough are fairly wooded, but not to the extent that the waste land and the hill ground seems to warrant. Towards the lower end of Tough, and about the centre of Cluny, on some small properties, a good deal of wood has been cut recently, but little planting has been done. Echt, Skene, and Castle Fraser are all well wooded, the second crop being in some instances almost fit for cutting. In proportion to its extent, the parish of Echt is the best wooded in the county. Since the estate

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of Dunecht came into the possession of the present proprietor, the conservation of the plantations has been steadily kept in view. At Castle Fraser some of the hard wood trees, but especially sycamores, oaks, and beech, grow as well as in most of the southern counties. The larch and Scots fir are, however, the principal crops; the latter being mostly at maturity, cutting down has been going on for some time, and the greater part will soon be cleared off. In the Skene district there has not been much cutting of wood for some time, although there are several Scots fir and larch plantations fully matured. Some of the young plantations are the second crop, and consist principally of Scots fir, spruce, and larch. Much of the ground was previously occupied by Scots fir. In some of the plantations there are still a few of these standing, along with some good beech, sycamore, and oak. From this towards Aberdeen there are several thriving patches of young wood, mostly narrow belts and clumps, the most extensive being at Hazelhead, Countesswells, and Craigiebuckler, where there are some good broad belts and clumps, chiefly of mixed hardwoods, with firs as nurses. The Scots fir and larch do not seem to grow so well, but there are some good silver firs, and elm and ash grow freely. Besides the ordinary forest trees there are good collections of shrubs, including rhododendrons, laurels, and holly, the three latter being quite at home. There are also a number of the newer coniferæ. At Drum Castle there are some good old Scots fir of the "Highland bonnet" type, but the Scots firs of from thirty to fifty years old do not appear to be so vigorous. Hardwoods are growing among the old Scots firs. Several young plantations have been formed, and in most of these, besides Scots fir, larch, and spruce, there is a mixture of the black Italian poplar. This tree seems to be well suited for the district, and there is reason to believe that it will occupy a prominent place in future arboriculture, especially in situations not suited for the growth of the Scots fir and larch.

From Park to Aberdeen, plantations are more detached and cultivated for ornament than profit. Several exceptions may be noted, as on the estates of Culter, Deebank, and Murtle, there are some fair sized plantations of mixed hardwoods with Scots firs, larch, and spruce, as nurses. None of the trees are of remarkable size, and many seem to have suffered from the want of thinning and judicious pruning during the earlier stages of their growth. Near to the mansion-houses there are good specimens of larch, Scots fir, beech, birch, chestnut, ash, *Cedrus Deodara*, &c. There are many villas

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and small mansionhouses in the outskirts of Aberdeen, and round these there are many interesting exotics. The different varieties of holly seem to grow with more luxuriance than is usual in the immediate neighbourhood of large towns. Visitors often remark that hollies seem to be natural to Aberdeen. Many fine specimens of the newer Coniferæ are grown in the suburbs of Aberdeen, such as *Cupressus Lawsoniana* and *Nutkaensis*, *Araucaria imbricata*, *Cedrus Deodara*, *Picea nobilis*, *Nordmanniana* and *Lasiocarpa*, *Abies Douglasii*, and species of *Thuja*, *Taxus*, &c. Besides these, varieties of deciduous trees are numerous and good.

Valley of Don.—Following the course of the Don from Aberdeen, except at Parkhill, there are no remarkable arboricultural features until Kintore is reached. Several patches of mixed hardwoods and fir clothe some of the steep banks, but of no great extent; the ground is better suited for growing corn than wood.

Parkhill is one of the best wooded properties near Aberdeen; the revenue from the woodlands is not neglected, but conservancy is the chief consideration. Thinning and pruning have been carried out in a judicious manner. The Scots firs are not of fine quality, but are healthy and growing well. Larch and spruce are smaller, and not so numerous. Oak and beech have had ample room for development, and having been judiciously foreshortened, the result is better specimens than are generally found in the north of Scotland. Coniferous trees are also numerous, not only in the vicinity of the mansion house, but throughout the woods; wherever a vacant space occurs a Douglas pine is planted, and it is wonderful how well these thrive amongst the old trees. Most of the coniferous trees are growing remarkably, and are tall for their age; they have been pinched and foreshortened until they are formal almost to a fault. Shrubs of many varieties are growing in great luxuriance. To the south, on the hill of Tyrebagger, there are some Scots fir and larch plantations, which are mostly at maturity.

In the district of Kinaldie and Fintray the plantations are mostly belts and clumps of mixed hardwood and firs. Most of these have been laid out with great care and taste, but there is not much old wood, and no great extent of young plantation.

At Kintore the woody district is again entered, and in this valley there is a great extent of wood under twenty years old, a large part being a second crop. It consists chiefly of Scots fir and spruce, with a small proportion of larch.

At Keithhall there are some good specimens of old ash, elm,

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gean, and spruce, the ornamental plantations and clumps are numerous, and laid out in a most systematic manner. They are chiefly hardwoods, planted close for immediate effect, with a few firs as nurses. On the high ground the plantations are extensive, and the firs are more numerous. The present management is good, and augurs well for the future. On the left bank of the river the Kemnay woods are fast disappearing, but these are mostly mature. As most of the ground thus cleared is unsuitable for agriculture, it will probably be replanted. On the right bank the plantations are small and detached. In some of the older plantations young trees (especially silver firs) are planted freely, to produce cover for game, the conservation of the woods being a secondary consideration. At Fetternear, park trees and ornamental clumps have been planted, and these are beginning to have some effect at a distance. The revenue to be derived will, however, be small compared with regular plantations.

Monymusk and Castle Forbes come next in succession, and are two of the best wooded properties in the county. At both places there are extensive sawmills, and the wood is manufactured at the instance of the proprietor. All the ordinary varieties of forest trees are numerously represented, but Scots fir and larch are the principal crop. At Monymusk the old wood of Paradise is the great attraction. Besides the famous larches, which take rank among the best in Scotland, there are splendid specimens of Scots fir, spruce, silver fir, and Scotch yew; also oak, elm, beech, ash, plane, and other hardwood trees. It would be difficult to name a place in the north of Scotland better furnished with fully grown arboricultural specimens. There is also a good collection of the newer coniferæ, but being much overshadowed by the larger trees, they cannot be expected to attain to great perfection, although the soil is most suitable for their growth. Near the mansion-house there are many large specimen hardwood trees, mostly at maturity. As a rule, more ground has been planted than cleared, but the young plantations have made little progress although some have been replanted. A hill-side, where a fine crop of old wood was cleared off a number of years ago, has been several times planted, but without encouraging results. Oak and hazel copse grows freely, but this is being gradually cleared out, and larch and oak substituted. A bobbin factory and a manufacturing sawmill being on the property the chief consideration in the management is a regular revenue. For some time this has decreased, but under ordinary circumstances there will

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be no difficulty in maintaining, and in a few years increasing, the revenue, so that the arboricultural prospects will compare favourably with the past, especially as there is a great extent of wood (Scots fir and larch) ranging from fifteen to fifty years old. The Castle Forbes woods are in many respects similar to Monymusk, and for many years a great trade in manufactured wood has been carried on. Larch and Scots fir of large size are now becoming scarce; but there is still a good extent of well-grown wood, between fifty and sixty years old, on both sides of the river between Benachie and Cairn William.* The young plantations are principally larch and Scots fir, the former predominating and thriving best. Most of these young plantations have been planted on virgin soil, and they promise to yield a handsome revenue at no distant date. In the parks around the castle there are good specimen trees of most of the common hardwoods and firs, and a few newer coniferæ have been lately introduced. On the right bank of the Don, above Castle Forbes, the plantations are more detached, the principal ones being on Whitehaugh, Littlewood, and Braes of Forbes; a number of them have been recently formed.

On the left bank of the river the principal plantations are at Tonley, Lynturk, Haighton, Breda and Brux. At all these places Scots fir and larch are the principal crop, and are growing in small plantations, belts, and clumps. There are also some fine old trees in the parks near the mansion-houses, but except the beeches at Breda, and some fine hardwoods at the Kirk of Tough, none of them require special notice. In the Cushnie and Towie districts, larch and Scots fir thrive moderately well, but there is *comparatively* little wood grown. A great part of the land suited for growing wood is at present pastured or lying waste, and some of the cultivated land would yield a higher rent under wood than under rotation cropping. The probabilities therefore are that a great extent of wood will be grown in these districts at no distant date.

Returning to the north side of the Don, there are some good mixed fir plantations, extending from the Braes of Forbes towards the Clova district. Although these are not so extensive as the woods of Castle Forbes and Monymusk, still they add considerably to the value and appearance of the district.

In some of the glens, particularly at the Burn of Craig, there are fine larches from seventy to ninety years old, tall, straight, and

* Since the above was written, 300 acres of this wood have been sold for the sum of L.17,000.

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apparently free from disease. Along the hillside belonging to Clova, Craig, Leithhall, Wardhouse and others, several fine plantations are getting up rapidly, and useful sparwood has already been supplied from this district. At Clova the larch grows with a good deal of taper, but the wood is of good quality. Spruce is growing freely on deep moss, and in the garden there is a good specimen of the *Araucaria imbricata*. Throughout the whole district there is still a great extent of ground—hill and dale—well suited for the growth of trees, and there is not nearly so much planted as the soil and the area of the district seem to warrant. At Kildrummy there are some fine specimen trees, especially larch. Scots fir is also of good quality. The hardwoods in the vicinity of the old castle are growing particularly well considering the district. Large tracts of young wood have been planted on the hills of Ardhuncart and Glasgul, principally Scots fir and larch. From Kildrummy upwards towards Strathdon young plantations are not so numerous, but there are some good belts and clumps of Scots fir, larch, spruce, and hardwoods at Glenkindie, as also some good specimens of old ash at Mains of Glenbucket. On the estates of Newe the Scots fir are of fine quality, and seem to be in their native habitat. At Forbes Lodge and Edinglassie there are good Scots fir and larch plantations on both sides of the water, with hardwood trees near to the mansion-houses. As yet not much has been sent to the market, as from some plantations it will scarcely pay the carriage. It is, however, used for local and building purposes, and for whatever is thus required good prices are readily obtained. Pit props from some parts of Strathdon would hardly pay the expense of transit, though got in the plantations free of expense. Wood grows so well throughout this district that it is probable a much greater extent of land will be planted, and if such were the case, the railway might be extended for the special transit of wood.

Valley of Deveron.—Leaving the Don, the next best wooded district is on the banks of the Deveron at Huntly Lodge,—the famous Binnhill, one of the largest plantations in the county, being on the north side, not far from the river. It is a mixed plantation of Scots fir, larch, and spruce. Larch is most numerous on the north and west sides, Scots fir on the south and east sides, with spruce on the mossy ground. The outside boundary line of the whole is Scots fir. The north, east, and west boundary is convex, and the south a double concave. On the north side of the river, from about a mile to the west of the Binnhill to the boundary of the county, a great

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extent of wood has been planted within the last twelve or fifteen years,—the whole of which is doing well. On the south bank the wood has been recently cut, but as the ground is unsuitable for agriculture it will probably be replanted.

The principal trees in the parks and policies at Huntly Lodge are beech, oak, lime, (very old) silver fir, elm and maple, plane, spruce, Scots fir, and larch; all of these are extra good when found close by the river. Most of the Huntly Lodge woods have been well thinned. Thinnings and firewood command a ready sale at fair prices. From Forman Hill to Huntly Lodge is well wooded, principally with mixed firs, the principal plantations being on the estates of Cobairdy and Lessendrum, some fine hardwoods grow by the waterside, chiefly ash, beech, oak and plane. Near to Turriff there is some good wood on the estates of Delgaty, Carnoustie, Auchry, Craigston, and Hatton Castle. The most thriving varieties are elm, plane, ash, spruce, and silver fir. Except in the glens the wood is not nearly so well grown in this district as in the western part of the county. At King Edward the wood is mostly grown in belts and clumps, and hedge-rows, and is chiefly mixed hardwoods. The principal young plantations are at Byth and Eden. Returning to the valley of Bogie there is good wood on the banks of the Bogie near its junction with the Deveron, as also at most of the mansion-houses in the district, but wood is not plentiful in Strathbogie,—the district being chiefly agricultural. The lower slope of the Benachie range might with advantage be more extensively planted as the trees already there are doing well. At Pitcaple and Logie-Elphinstone wood of all sorts grows freely, and there is a good extent extent of young plantations (chiefly Scots fir, spruce, and larch) coming on. Most of the matured wood has been felled, and a great extent of the ground replanted, which is doing well. Elms, planes, and oaks are plentiful in the parks and policies and along the road side, but not of any great size. There is very little wood grown in the upper part of the Garioch district, the ground being chiefly arable, but there are a few hedge-row trees, and hedges, which are doing well. On the south slopes of the Foundlin hills there are some larch and fir plantations, and also some good hardwoods; but the subsoil is slate, and not adapted for the growth of wood; still the result is not discouraging, as the wood that has grown is more profitable than any other crop would have been. In some of the sheltered glens about Sheelegreen larch and Scots fir, and even plane, beech, and oak, are doing remarkably

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well considering the situation. The Scots fir are coarse but useful, and the larch are "carroty shaped," but of fine quality, and when used for fencing purposes last for a very long period. Throughout the Formartine and Buchan districts the woodlands occupy a small area compared with the extent of the district, with the exception of Meldrum and Haddo House, the principal plantations being in the immediate vicinities of the mansion-houses and policies, and are cultivated more with a view to ornamental effect than for profit. The plantations at Meldrum and Haddo House are the most extensive in the district, and manufacturing sawmills are kept up at both places. Larch and Scots fir are the principal varieties, but oak, birch, and hazel copse grow freely in some of the glens. A number of young woods have been formed recently; the most prominent of these being the hills of Barra, Bourtrie, and Thornton, the former was planted by contract at 13s. per acre. Thorn and beech hedges grow freely. The district is highly agricultural, and in a country where there is so much land suited for growing trees (where a crop of wood is the only profitable crop it will produce), it would not be advisable to occupy much of the arable land with wood. Still, even in this district a good deal of wood could be grown with advantage, and there is no doubt that in future a fair proportion of wood will be planted to provide shelter for the agricultural crops and cattle. Some of the waste lands might also be planted with advantage, and if the Foveran sands or such places could be covered with wood a great advantage would have been gained. It is probable that a fair trial of this experiment will be made at no distant date.

Hedges form a prominent arboricultural feature, and in districts such as Buchan, Formartine, and Garioch, where trees are not extensively grown, live fences might be more extensively introduced, especially where stones for building dykes are scarce.

Such is a brief outline of the present state of arboriculture in Aberdeenshire. The extent under wood is 115,000 acres, the greater portion being in the western division. Scots fir and larch are the principal trees grown for profit. The hardwoods are chiefly found within the parks and policies as specimen trees in belts or small clumps. There are scarcely any hardwood plantations, or even mixed plantations with hardwood, as the principal crop far removed from the mansion-house or policies, some woods of natural birch being the only exceptions.

An exact classification has not been arrived at, but the following

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is an approximation of the relative ages of the woodlands at this date, viz. :—

	Acres.
Wood at 70 years old and upwards, . .	4,500
Do. from 50 years to 70 years old, . .	26,000
Do. from 20 years to 50 years old, . .	35,000
Do. under 20 years old, ...	47,000
Do. within policies, ...	2,500
Total, . . .	115,000

From these figures it will be seen that, in regard to acreage, the future will compare favourably with the past and present. Still there are many obstacles to prevent the future plantations from realising the same revenue as at present. No doubt in many cases a much higher revenue may be reasonably expected, but many of the young plantations recently formed are distant from the market, and some occupy places almost inaccessible. In such situations, (unless a great expense is incurred by the proprietor in the formation of roads previous to disposing of the wood) the receipts must necessarily be very small. It is probable that as the wood traffic increases, railways may be extended, or temporary tramways laid down as feeders for the permanent lines. Some years ago, when traction engines were introduced, it was thought that the transit of wood would be effected more expeditiously and cheaply; but the use of traction engines having met with opposition from the road trustees, there is little advantage to be expected in that direction for some time. Workmen's wages are also increasing rapidly, and with the present outlets and depôts for wood, there are many places in West Aberdeenshire where even good pitprops scarcely pay the cost of cutting and transit.

That is the dark side of the picture; but with improved management of woods, it is reasonable to expect that a better class and crop of trees will be grown. Appliances for the cheaper manufacture and transit of wood may also be introduced. Besides, as the prosperity of the country advances, the demand for wood will also increase, and it will consequently rise in value. Such has been the experience gathered from the past.

Foreign wood will also become more difficult to procure; and as general cultivation advances, even in these countries where the wood supply has been considered inexhaustible, the woodlands will

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recede from the rivers and lines of transit. All these circumstances tend to make wood scarcer, and the price will necessarily increase; in fact, during the last three years the price of wood has increased at least 20 per cent. Apart from the direct value of timber, wood exercises a benign influence on the agriculture of a district, so that to improve the agriculture, the aid of arboriculture must be called into requisition in providing shelter for the crops and herds. This is especially requisite in a county like Aberdeen, the north and east coast of which is much exposed to the cold cutting blasts. It is not necessary to cultivate large tracts of wood in that part of the county, but without doubt there ought to be a fair proportion of belts and clumps of wood, along with the more general introduction of hedges. There is considerable room for improvement in respect to these points throughout the greater part of East Aberdeenshire.

Looking at the future of the county, it is probable that arboriculture will occupy a more important position in estate management than now, although the present time compares favourably with the past. From the approximate classification, it will be seen that the woodlands have increased considerably during the last twenty years. It is also to be observed that a great part of the new wood is on hilly ground, not previously occupied by trees. The prospective value of the whole, taken at an average of L.45 per acre, which is a low estimate, would be L.5,175,000, or sufficient to yield a yearly revenue of upwards of L.100,000. Besides this, it is no exaggeration to state that the area of woodland in the county could be doubled, and a great extent, which at present is covered with natural birch, &c., could, by judicious management, be made to grow more profitable kinds. It is therefore probable that if the woodlands of Aberdeenshire were fully developed and extended, an annual revenue of about L.200,000 might be realised. This sum, besides increasing the income of landed proprietors, would indirectly benefit the railway companies, and tend to develop the rural industries.

The want or neglect of thinning is one of the greatest dangers to be apprehended in the recently-formed plantations. Many of these have been planted at 3½ to 4 feet apart, and some at 3 feet apart, and as most of them have succeeded well, they invariably are, if not previously thinned, perfect thickets at from 12 to 16 years old. The distance from market makes the thinnings of no value at that age, and workmen's wages being high, it is often

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difficult to have the plantations thinned judiciously in due time. The usual plan is to leave all alone until they are fit for pit-wood, &c., or till the strong overgrow the weak. This apparent difficulty may in the future be more easily overcome than at present.

In agricultural and grazing districts, where the principal consideration in growing wood is other than its pecuniary value, the proper conservation should be the chief aim in the management. On several estates in the county this is at present the principal object, and in agricultural districts it is often the most profitable management that can be adopted, and as its indirect benefits are seen, it will be more general than at present.

The largest ornamental plantations are in the parks and policies of Haddo House, Fyvie, Pitfour, Parkhill, Dunecht, Fetternear, and Keithhall. Scots fir, larch, and spruce are the trees mostly grown throughout the county, but it may be interesting to note where good specimens of the following trees may be found:—

Norway Spruce (*Abies excelsa*)—Aboyne, Invercauld, Abergeldie, Midmar, Monymusk, Whitehaugh, Castle Forbes, Haddo House, and Huntly Lodge.

Silver Fir (*Picea pectinata*)—Pitfour, Strichen, Huntly Lodge, Cluny, Midmar, Ballater, Invercauld, Breda, Haughton, Monymusk, Hazelhead, and Culter.

Plane (*Acer Pseudo-Platanus*)—Craibstone, Kinmundy, Leithhall, Glenkindy, Newe, Cluny, Aboyne, Castle Fraser, Drum, and Monymusk.

Alder (*Alnus glutinosa*)—Birse, Aboyne, Invercauld, Huntly Lodge, Delgaty, Haughton, Breda, Strichen, Culter, and Drum.

Horse Chestnut (*Æsculus Hippocastanum*)—Craibstone, Culter, Echt, Pitfour, Balfling, Skene, Aboyne, and Invercauld.

Birch (*Betula alba*)—Invercauld, Abergeldie, Birkhall, Finzean, Aboyne, Breda, Kildrummy, Ballogie, Cluny, Monymnsk, and Haughton.

Hawthorn (*Cratægus oxyacantha*)—Aberdeen, Pitcaple, Cluny, Leithhall.

Spanish Chestnut (*Castanea vulgaris*)—Waterton near Ellon, Pitfour, Tonley, Monymusk, Castle Fraser, and Aboyne.

Beech (*Fagus sylvatica*)—Huntly Lodge, Aboyne, Balfling, Cluny, Philorth, Pitfour, Kemnay, Echt, Midmar, Hallhead, Meldrum, Balbithan.

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Ash (*Fraxinus excelsior*)—Huntly Lodge, Cobairdy, Craibstone, Strichen, Cluny, Castle Fraser, Kemnay, Leithhall, Glenkindy, Abergeldie, Invercauld, Aboyne, Tonley, Haughton, Newe.

Walnut (*Juglans regia*)—Westhall, Kemnay, Craibstone, Midmar, Huntly Lodge.

Holly (*Ilex aquifolium*)—Ellon, Culter, Drum, Midmar, Finzean, Balogie, and Aboyne.

Mountain Ash (*Pyrus aucuparia*)—Invercauld, Glengairn, Glenmuick, Midmar, Newe, Strichen, Edinglassie, Dee Castle.

Wild Cherry (*Prunus Cerasus*)—Cluny, Edinglassie, Huntly Lodge, Echt, Keithhall, Glengairn, Birkhall.

Poplars (*Populus monilifera* and *canescens*)—Kemnay, Manar, Tonley, Aden, Strichen, Aboyne, and Echt.

Aspen (*Populus tremula*)—Aboyne, Invercauld, Ballater, Dee Castle, Castle Forbes, Glenkindy, and Kildrummy.

Huntingdon Willow (*Salix alba*)—Edinglassie, Philorth, Aden, Echt, Castle Forbes, Fetternear, Glenkindy, Birkhall, and, Aboyne.

Lime (*Tilia europœa*)—Ellon, Philorth, Birkhall, Aboyne, Strichen, Huntley, Aden, Monymusk, Castle Fraser, Cluny, and Leithhall.

Oak (*Quercus Robur*)—Philorth, Pitfour, Aden, Strichen, Culter, Drum, Skene, Monymusk, Cluny, Breda, Haughton, Huntly Lodge, Aboyne, Ballater (natural).

Scots Fir (*Pinus sylvestris*)—Seaton, Parkhill, Drum, Philorth, Strichen, Wardhouse, Leithhall, Haughton, Castle Forbes, Whitehaugh, Monymusk, Cluny, Midmar, Newe, Huntly Lodge, Aboyne, Ballater, Abergeldie, Invercauld, Mar Lodge, Fyvie.

Larch (*Larix europœa*)—Aden, Strichen, Culter, Kemnay, Ward-House, Cobairdy, Newton, Abergeldie, Invercauld, Mar Lodge, Aboyne, Leithhall, Clova, Breda, Haughton, Monymusk, Cluny, Learney, Midmar, and Drum.

Yew (*Taxus baccata*)—Culter, Ellon, Midmar, Leithhall, Monymusk.

Elm (*Ulmus montana*)—Huntly Lodge, Cobairdy, Pitfour, Craibstone, Cluny, Monymusk, Drum, Echt, Edinglassie, Invercauld, Aboyne, and Birkhall.

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XXVI.—*On the Draining of Plantations, by Open or Covered Drains.* By LEWIS BAYNE, Forester, Kinmel Park, Abergele.

The influence of the drainage of land on the growth of crops of all kinds must be apparent to every one engaged in agricultural pursuits. Its introduction is one of the greatest improvements in farming, and also in modern forestry; for the preparation of the ground by thorough and judicious draining is essential to the proper formation of plantations, and to the renovation of ill-thriving ones, as there is small chance of success where trees are planted in wet undrained soil.

To draw away from the ground a commodity, which in dry seasons is so useful, and the want of which causes many young trees to die, seems strange. But it will be found that, by judicious draining, the necessary supply of moisture is not taken from the soil, but only the *excess*, and that the soil will retain a supply of moisture; while neither extremely dry nor very wet seasons will so injuriously affect the plants as on undrained land. But drainage produces beneficial effects besides removing superfluous water from the ground. When land of a clay or tenacious nature is filled with *stagnant* water, all atmospheric influences are curtailed, and the plants are not only deprived of their proper nourishment from the soil itself, but the presence of noxious substances in their vicinity injures their health and cheques their growth. Ground in such a condition is naturally in a very cold state; and as the water can only, to a certain extent, be got rid of by the process of evaporation, the heat of the sun's rays, instead of warming the soil, is taken up with this operation. But while the ground is relieved of the water by this process, its poisonous ingredients remain in the soil, and the greater coldness of the atmosphere and of the ground, along with the excess of moisture, in time rots the roots of trees, and renders them more liable to be blown down by wind.

Having noticed the bad effects of an excess of moisture on the soil and its crops, we come to the benefits arising from thorough and proper drainage. By removing superfluous water from the soil, a way is made for the air to aid in decomposing the organic substances, which become the food of the plants, and ingredients which are hurtful to plant growth, and which cannot otherwise be removed, are carried off by rain. Not only does the removal of extra moisture

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make land more dry, but it allows the soil to have the full benefit of the sun's heat, rendering it warm and congenial to plant growth, and ready to benefit by the least shower of rain, at the same time raising the temperature of the surrounding atmosphere. Draining also makes soil of a stiff or tenacious nature more friable, and better prepared to receive the fibrous rootlets of plants, and by the action of the atmosphere hard pans or crusts are broken and pulverised, so that the roots may enter them, a result which could not otherwise be obtained without subsoiling or trenching.

Before commencing the operation of draining many things are to be considered, such as the kind of drains to produce the best and most lasting effect upon the ground, whether they should be open or covered? Again, if covered drains be best, whether they should be laid with drain pipes, or tiles; or should the bottom consist of stones set on edge in a triangular form, with a few inches of broken stones over them, or be filled with broken stones to the depth of a foot or 15 inches? and the best line to run the drains, the depth, and the distance one from another, so as most effectually to dry the ground at the least expense, are points calling for careful consideration. These may be usefully dealt with in detail.

First, As to the kind of drains. Open drains are most used for plantations, and have many advantages over covered ones, whether laid with tiles or stones; the greatest objections are, the liability to become choked with soil, leaves, branches, &c., which necessitates their being often cleared out; the width necessary to keep them from falling in when of good depth; their inconvenience in the removal of timber, and their unsightly appearance in home plantations. But where the surface water is the great evil to be removed, they render the ground dry although of no great depth, and are therefore not so objectionable in such circumstances. In few cases, however, is surface water the only moisture to be removed, and open drains are seldom effective if less than two feet deep, however close they may be to each other. Covered drains, on the other hand, especially in hardwood plantations, are liable to be choked by the roots of trees, and this, after heavy rain, causes the water to burst up and saturate the ground, making it more wet than if it had not been drained; another result of this is that the roots of the trees are starved and rotted, and the ground made so spongy and soft, that the least storm of wind may overthrow the trees. Such effects are often seen in home parks and demesnes, where trees are growing near to covered drains, and the work of lifting, clearing, and relaying

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the pipes, while destructive to the roots of trees, entails considerable expense, because, after the roots have once reached the pipes, these operations have to be often repeated. We have seen pipes, tiles, and stone drains so choked with tree roots, that it was impossible to extract the mass without breaking the pipes. In such cases, the drains had been made after the trees had arrived at considerable size, but the result would be equally bad in young plantations, although the time of destruction might be postponed. Elm, ash, and poplar are most destructive to covered drains, as they choke them with their roots in a short time, even if growing at some distance. Larch, spruce, and other surface rooting trees are not so liable to cause injury in this way, and covered drains may therefore be adopted more effectively in fir plantations, than among hardwood trees, for the removal of bottom water.

The liability to injury of covered drains in hardwood plantations is much to be regretted, because they can be made with equal convenience to any depth, and but for this objection, would not only dry the ground to a greater depth, but would save the trouble and expense of clearing open drains, which often get filled with soil, leaves, branches, herbage, &c. It has often been observed that drains which had not enough of water to run when open, on being laid with pipes, and covered in with soil, worked efficiently; and the effect is the same in the case of drains with little fall or nearly level, the water will stand in the drains when open, and even follow the drainer as he finishes the drain, but when it is laid with pipes and covered in, the water will flow immediately.

Notwithstanding what has been said, however, open drains are to be recommended generally for plantations in respect of their non-liability to be damaged and plugged by the roots of trees. If kept clear of leaves, branches, &c., and cleaned out as often as may be necessary, they will in most cases produce the desired effect, if properly and thoroughly made. It may not be out of place to make some observations in regard to covered or furrow draining, as well as open draining, as there are situations in the range of most foresters, where open drains would be out of place and impracticable. Of the different kinds of covered drains, those laid with pipes or tiles claim the first place, with this qualification, that where stones are abundant, and pipes or tiles are distant, stones may be used for this purpose as a good way of disposing of them, when not required for fencing, road-making, or other estate purposes.

Covered drains should never be less than 3½ feet deep, while

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they need seldom be more than 4 feet. The main drains will, of course, be a few inches deeper, according to the size of pipes to be used, and this will depend upon the wetness of the soil, and the number and length of the common drains to run into the mains. Pipes with a bore of 1½ to 2 inches are usually large enough for common drains. Pipes with collars have many advantages over tiles or pipes without collars. These assist to keep the pipes in their proper position, and prevent any sediment from entering the joints, and the pipes are more easily and quickly laid in the drains. Before the pipes are laid, a little straw is good for forming a clean and firm bed where the ground is soft, or very wet and slushy; the wooden and tile soles often used are liable to sink at the ends in soft ground, and the straw bed therefore is preferable. If main drains or leaders are of great length, or if two or three unite at a given place, a cesspool or tank may be made to receive any sediment that may be in the pipes; it may be built with bricks, or stones and mortar, as most convenient, say 6 feet long, 2 wide, and 2 under the flow of pipes in depth, floored with pavement stones, and covered with the same material, or wood, to open with a lid or door. The length stated facilitates its being cleared out, giving room for the use of the necessary tools, which would not be the case if the cesspool were 2 or 3 feet square.

Open drains should seldom be less than 2 feet deep, and they are inconvenient in many respects if more than 3 feet deep, except in particular cases. In young plantations, open drains 2 feet deep, 3 feet 4 inches wide at top, 6 inches at bottom, and from 24 to 40 feet apart, act well and give satisfactory results. A width of 3 feet 4 inches at top gives a good slope to drains 2 feet deep, and with corresponding widths at top they may be made to any desirable depth. But the narrower open drains are at the bottom, the better will the water run, and the less liable are they to be choked by leaves, &c. Confined to a limited space, the water acquires force, runs more regularly, and thus more easily carries away leaves and small particles of soil with it. If the water were allowed to spread over a foot or more of bottom surface, any small obstacles would be backed up with such soil or leaves as might come down the drains, and in a short time the deposit would become quite fast, and when heavy rains came, causing an extra flow of water, the flood would be forced into the sides, and undermine the slopes of the drains, which in time would fall in, causing trouble and expense in repairs. It is evident that the greater the breadth at the top, the more

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secure will the sides of the drains be from falling in, for when cut straight down in loose and friable soil, and especially after frosts and heavy rains, when the ground is soft, and a strong run of water flowing, the risk of injury to the sides is very great. But when the soil is stiff or tenacious, less slope will be necessary. Open drains 1½ feet deep are sometimes sufficient to dry the ground, where there is only surface water to contend with; but as a general rule, drains less than 2 feet deep will not dry even the surface soil sufficiently for the reception of young plants. On the other hand, when over 3 feet deep, they are not only inconvenient in the removal of thinnings or timber from the plantation, but they require great width at top, and take up more room than can be spared where close draining is necessary. It is however impossible to fix any definite depth for open drains, as 2 feet might answer the purpose on some soils, as well as 3 feet in others, but 2½ feet is a good average depth. In draining peat bog or other soft soils, containing a large quantity of organic substance, an additional depth should be allowed for subsidence as the water is removed, and if a stratum of gravel or clay occurs at no great depth, it is well to reach it so as to give the drains a solid bottom, as well as to dry the ground more thoroughly. In forming plantation drains, the soil taken therefrom should be spread between the drains, so as to make little weight on the sides. If such soil be left on the margin, its weight would tend to make the sides fall in, and the soil so left would crumble and be washed into the drains by heavy rains in a short time; but by spreading it towards the middle, the centre is in a manner ridged up, and during heavy and continued rains (especially in tenacious land), the water, instead of remaining on the surface, at once flows towards the drains, and the roots of the plants are free from stagnant pools; the ground is thus more dry after the trees have grown up, even should the clearing out of the drains be neglected.

The distance between drains, whether open or covered, depends upon circumstances. The nature of the soil and the depth of the drains require to be considered, as the more open and porous the soil is, and the deeper the drains are formed, the greater will be the distance at which they may be made, and *vice versa* in stiff tenacious soils with drains of less depth; but it is seldom necessary to have covered drains closer than 15 feet from one another, and open drains 24 feet apart between centres, or at greater distances from each other than 40 feet. When open drains are closer than 24 feet at 2 feet deep, they become inconvenient, taking up much room, and

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leaving so little space between, that trees cannot sufficiently spread their roots, and are thereby liable to be overthrown by wind. When, therefore, that interspace (24 feet) is too great for open drains 2 feet deep, it would be preferable to have covered drains, rather than open drains of that depth, closer to each other, or the ground may be intersected say every 50 or 60 yards with open drains 4 feet deep, running into a leader or main drain 3 inches or so deeper, with open drains 2½ or 3 feet deep, and 30 feet apart between the 4 feet drains. If merely surface water is to be removed, and the soil is of a retentive nature, drains 18 inches deep and 20 feet apart may produce the effect without adding to the cost. On the other hand, when open drains are cut at a greater distance apart than 40 feet, even if 3 feet deep, they have little effect in removing either bottom or surface water from the centre of the intervening space, and in land requiring so little drying, a few well laid out drains 2 feet deep may answer the purpose. Open drains 4 feet deep alone, at the required distance apart for the draining of wet ground, are objectionable, on account of the great width at top required to keep them from falling in, and they are otherwise inconvenient and costly.

The direction or line in which drains are run, so as to produce the best and immediate effect, by the removal of stagnant water, &c., must depend on the natural lie or fall of the ground. Main drains or leaders should always be made in the lowest parts of the ground, and have as free an outlet as possible. Too great a fall should, however, be avoided, as the water received from the sub-drains after heavy rains acquires such force as, in the case of open drains, is liable to damage the sides or bottom. When, therefore, the ground is hilly, or has a steep slope, with an extent of level land at the bottom, a main or leader or sub-leader drain may be cut along the bottom, so as to drain the level ground, and another for the reception of the water from the slopes. Without such an arrangement, if there is much water running in the small drains down the slope, it will flow with great force to the bottom, and run more slowly on the level portion, thereby any soil or sediment carried down by current is left on the more level part from the want of force to carry it to the outlet, filling up and choking both open and covered drains in the course of one or two seasons. But by having a main drain for each portion this is avoided, as the greater run of water in the main drain from the small ones carries any sediment from the slopes towards the outlet.

Many opinions exist as to the direction in which small drains, whether covered or open, should run. For a long time, and until

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lately, it was a prevailing idea among practical men that oblique drains, whether covered or open, *across* the natural inclination or fall of the ground, were the most effectual, in the belief that such drains would in that way *catch* the water as it came down the slopes; and many still consider this the proper course as regards open draining. But as drains are made to receive infiltrated water from the soil as well as surface water after heavy rains, the best system is to make the drains run with the natural inclination of the ground. In this way the drains have a good run or declivity, which is important to promote an easy flow of the water collected, and they are also of nearly equal depth on both sides, and so have the greatest drawing or receiving powers in all directions, and from all quarters. On the other hand, when drains are run obliquely or at right angles, on moderately sloping ground, say at 24 or more feet apart, the bottom level of the drains will be reached at a few feet from the under side, while the water will have to descend several feet before arriving at the level of the adjoining under drain, and such drains would therefore in a great measure act from the upper side. Again, by the former method, springs and wet patches are more sure to be tapped and the water removed than by the oblique or cross system; the latter in many cases misses them, even if of greater depth than drains cut in a straight line down the slope, and so the ground is little benefitted by the labour and money expended. But in the case of very steep hills or mountain sides, where there is a great flow of water, the perpendicular system may with advantage be deviated from, especially as regards open drains, as the sides are liable to be undermined by the too rapid flow of the water. In such circumstances, therefore, the drains should run in an oblique direction, not quite at right angles, but at as acute an angle as practicable; and it is advisable to shorten the length of the drains, and thereby lessen the quantity and run of water, rather than have the drains at right angles.

All drains should be made with as equal a gradient as possible, so that they may run regularly, and not have a rapid and slow flow alternately, causing them to be filled up and choked in the lower places.

The length of drains, open or covered, must be determined by the fall of the ground and the quantity of water they are likely to contain; but in no case, except under special circumstances, should covered drains run more than 300 yards,—and 200 yards will generally be sufficient for open drains; while, if the flow of water is strong, and the ground very steep, half that distance will be enough.

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In draining a portion of ground for planting or other purpose, a great variety of soils may be found within a small area, requiring the drains to be made of various depths, and at different distances. For example, in 1872-3, thirty acres of land to be planted varied so much, both in the nature of the soil and in its wetness, that in some parts drains 2 feet deep were cut at distances varying from 24 to 40 feet, and a portion did not require any draining at all. The drains were all 40 inches wide at top and 6 inches at bottom, and the soil well spread back between the drains; and although the subsoil was in many cases of a tenacious nature, the result of the draining has in every way proved satisfactory, as on the most wet and level parts the ground has become firm and dry. It may also be mentioned that the ground had been deeply ploughed in preparation for the planting, which materially assisted in producing the successful result. Indeed, it will invariably be found that stirring or loosening the soil, either by trenching or ploughing, is an essential preliminary operation, and gives the drains a better chance of producing an early effect than would result from draining alone.

The beneficial effect of drainage of wet and cold land upon the health of plants is sometimes seen in a striking manner when performed some time after trees have been planted. An instance of this was observed by me four years ago. A plantation, consisting of Scots fir, larch, and spruce, had been made some years previously; the ground had been sown with gorse as a cover and for shelter, the position being very exposed. The gorse in some parts grew only a little, while in other parts it never made its appearance, and the trees over the whole space made small progress. The spruce had assumed a yellowish-green colour, and the larch was covered with a superfluity of cones, two unmistakeable signs of disease and premature decay, caused by unsuitable soil and excess of moisture. Only a few cross or oblique drains had been made at the time of planting, and these were placed about 30 yards apart, and were 15 inches deep. With the view of improving the growth and appearance of the plantation, by rendering the soil more suitable for the trees, it was all thoroughly drained to a depth of 2 feet, the drains running parallel with the natural slope of the ground, and 24 feet apart. In casting the drains it was seen that the first foot would be of little use in drying the ground, as much water was below, but the second foot had the desired effect; a great quantity of water flowed off in a short time after the drains were cut to that depth. The subsoil was of a hard gravelly clay, with numerous large stones,

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and therefore the drainage was a difficult operation, requiring great labour, but when finished it was completely successful in drying the ground, and the effect on the plantation was very marked. The first summer after draining the spruce and larch assumed a more healthy look, and the whole plantation is now in a thriving state; and this, I believe, is entirely due to the drainage of the ground.

In draining old plantations, say over thirty years old, containing hardwood trees, great care must be taken in selecting the more open parts, and laying out of the drains to avoid cutting the roots of the trees as far as possible, even should the drains not be equi-distant, nor in altogether straight lines. Again, in cases of extreme wetness, it is advisable to drain the ground moderately at first, and to deepen the drains at different times afterwards, until the desired effect is attained, as it will be found that after the trees have been growing a length of time in extreme wetness, a sudden change in the moisture and temperature of the soil, caused by draining off all the water at once, would injuriously affect them.

The difference between drained and undrained land was remarkable during the very wet season of 1872, when even the best made drains were taxed to the utmost, and well drained land was not too firm or dry, while undrained land inclined to be wet became a regular marsh.

When trees are planted on undrained wet land, they soon become sickly, and covered with lichens; the fir and evergreen kinds become yellowish green, stunted in their growth, and covered with cones, sure signs of premature decay and disease, sooner or later followed by the death of the plant.

In forming covered drains, it is best to have the pipes laid and the soil filled in each night as the work proceeds. To execute drains badly, whether covered or open, is a useless sinking of money, especially covered drains, the making of which requires the greatest possible care in laying out, having proper depths, and laying pipes properly in a smooth well finished bottom.

From the differences and varieties of soil and subsoil, the value of labour in different localities, and the various depths to which drains are made, no definite statement as to prices can be given in this paper, farther than that, in ordinary circumstances, open drains might be made 2 feet deep, and the soil spread, from 1s. 10d. to 2s. 9d. per chain, and 4 feet covered drains, opened and filled in, at from 2s. 6d. to 3s. 6d. per chain of 22 yards, and at proportionately less rates in peaty soils.

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XXVII.—*On the Conservation of Old and Remarkable Trees in Britain.* By ROBERT HUTCHISON of Carlowrie, F.R.S.E.

There is at the present day, in the mind of every true lover of Arboriculture, the same deep-felt and wide-spread desire to preserve the bloom and vigour of life's early years in the hoary and venerated forms of the remarkable trees that fall under his notice, as, in the middle ages, existed in the thoughts and aspirations of the alchemists and physicians who sought, by the aid of the "*philosopher's stone*," or the "*elixir vitæ*," to ward off the ravages of time or the infirmities of old age, and to restore the fair freshness of youth to the withered form and wrinkled visage, in whose well-marked furrows disease and decay were too plainly, though silently doing their work. In fact, rejuvenescence is the one grand poetic idea of the universe; it pervades all the operations and minutest processes of nature. In the vegetable world, death and decay are everywhere followed by renewal; from the tiniest hedge-flower to the giant forest oak, the lesson is taught us of active and incessant decay, counterbalanced by active and ceaseless reconstruction; so that the earth's surface is maintained, as fair and as verdant in youth as it was when the first morning's sun shone upon creation.

Notwithstanding this compensating and recuperative power in nature, however, the slow growth of most of the species of timber-trees in this country renders the conservation of old and remarkable subjects, whether they be notable on account of their dimensions or appearance, or from some historical association, highly desirable; and any measures that can be suggested for arresting the ravages of time and age must be valuable, and deserving of the careful attention of every lover of the picturesque and beautiful. Nor is it wonderful that the desire to preserve fine old individual trees should be so general, when we consider the value which scientific observation, and the experience of many years on continents, such as that of India, have taught us, of the preservation of a due balance of wooded land for the benefit of climate and rainfall. In the present utilitarian age, we are too apt to overlook the value of plantation ground, and to wish rather that it were devoted to the culture of food-producing cereal crops for the increasing population of our islands; but this is now shown to be a mistake, and it is clearly demonstrated, that a sufficient area of wooded land is as essential for the due development of the agricultural economy of any country, as the tillage of

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the soil itself, or the application of the seed to the ground. It may be partly owing to our climate, but chiefly to the vast supplies of coal with which our island is favoured, that the British nation throughout the globe is known as the most regardless of the value of forests; and in many foreign parts, emigrants from our shores are now feeling the want of timber, for shelter, shade, or climate adjustment, which their own reckless indifference has destroyed. The proper conservation of individual old trees fosters a general feeling for a careful attention to the growth and treatment of groups, plantations, and forests, and leads to a better acquaintance with a branch of Arboriculture too little understood at the present day.

In considering the question of the conservation of large trees, the subject naturally divides itself into two heads, each of which in its mode of treatment is entirely distinct from the other. 1*st*, Conservation may be directed towards the maintenance and development of trees *in progressive vigour*—to old large timber trees still enjoying health, and whose grateful shade, or graceful outline, in sweeping arms, it may be desirable to foster for amenity or picturesque effect in the landscape or park. Or, again, 2*d*, It may be requisite that steps be taken for the conservation of some old gnarled bare trunk, whose hollow stem and blasted head bear witness to the flight of many centuries, and around whose venerable form cluster memories and associations of historical or family interest or traditionary lore, which it is well to keep alive in the minds of a countryside by the preservation of the trees themselves, whose very names refer to the events their presence commemorates.

The steps to be recommended for the conservation of old trees, under either of the foregoing heads, are naturally much alike, and simply embrace measures of a remedial nature, taking in both instances due cognisance of the elementary principles of vegetable life in the tree. If trees were, in the early stages of their growth, to receive that care and attention which their importance demands, and which their ultimate value will show to have been necessary, there would be little need for the adoption, in later years, of measures to promote their progressive vigour and ultimate recovery from premature decay or decline. Early and fearless thinning, so that the young tree may find ample scope and free air for the development of its youthful form, is one essential requisite too often neglected, and the oversight of which is one of the most fruitful sources of early decline in old trees. In trees, as in the animal kingdom, the true secret of success in promoting a full physiological

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development, and maintaining a healthy frame, consists in prompt attention to early habits and appearances, and in checking in youth what might prove baneful to the constitution of the plant in later years. This may be called *the prospective or active treatment* for the maintenance of progressive vigour in trees. The other treatment involves the arrestment of decay or decline in individuals already evincing symptoms more or less defined; and, while the measures to be adopted are based on the same principles of the growth of vegetable tissues in the tree, they can never be so satisfactory, nor so remedial, as the same steps would be if taken in the case of younger and more vigorous subjects. The method of treatment in regard to such trees may be styled *the retrospective* or *passive.*

Before, however, proceeding to suggest the various remedies which seem limited to these two classes of old trees, it may, perhaps, be as well that we should cursorily notice the principles of vegetable growth and structure in tree-life, to which reference has been made.

All organic beings commence their existence at the bottom of the scale, and assuming one type of life after another, finally acquire the parent type or form. The perfect state of one organism is only the embryo form of another—the highest forms being merely the sum or aggregation of all the lower series. Thus the oak tree combines within itself all the various divisions and peculiarities of structure upon which the classification of plants is based. Its wood is, as all are well aware, *exogenous, i.e.*, growing from within outwards; its bark is *endogenous, i.e.*, growing from without inwards—hence its rugged and serrated appearance of trunk,—and its roots are *acrogenous, i.e.*, growing at their extremities. So it is that the various distinctive characteristics of the vegetable kingdom are embodied in the oak. The cell is the organic atom, the basis of all life. How the cells forming the tissues of the smallest plant, or the wood of the heaviest oak were formed, we cannot comprehend. It is one of the profoundest mysteries of creation. All the innumerable varieties of form, colour, and condition in the vegetable kingdom, arise or result from the conglomeration or combination of cells, and from this source spring the various phenomena of growth in the higher plant life, such as that of trees. In these the cells, as soon as formed, die and give birth to others; but they do not, as in the case of animal cells, decay and dissolve or change into gases or mineral substances, but become enclosed in the tissues of new cells, and are thus preserved from the action of weather and alternations of temperature, the exposure to the influences of either of which would

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rapidly decompose them. "They afford soil and mechanical support to the new cells. The new cells in their turn give birth to other cells, and in their turn die, and their offspring encloses them again in their protective mantle. Thus the growing tree goes on and stops, grows old and becomes young again, ends and begins, until it has reached its highest ideal of form, and its longest term of existence." The difference between plant life and animal life is, that the former exists and is promoted by the growth of *additional* cells, while the latter is maintained by the means of *substituted* cells. Thus a tree may be said to have within its trunk only one generation of active living cells at one time; year by year this one series of active cells becomes dormant, and is replaced or rather is added to by another series or generation, while there are as many generations of dead or inert and inactive cells built up in the tissues of the wood of the tree as it is old. Only the present year's growth may be held to be active; the rest is entirely composed of past generations of heart-wood, not literally dead, but inactive and passive, and which would decay were it not for the protection from the weather and alternations of climate which the living layers of tissue outside afford. Year by year the sap adds new tissues to the structure, just as the blood circulation in animal economy is requisite to repair and replace the decayed waste tissues; and as in the animal world, in the period of youth, the restorative process is more powerful, and new tissues are then added to the old; and in maturity, the relative processes of reproduction and decay are equally balanced; while in old age the destructive or declining process outruns the restorative,—so, in the vegetable kingdom, during the younger years of plant or tree life, corresponding processes are at work, which tend, during the various stages of growth, maturity, and decay, to similar results.

In attempting, therefore, to conserve old timber trees, and bearing these vital principles in view, attention must be directed, in the case of large trees still vigorous, though evincing incipient signs of decay, to the prolongation of the growing period of the tree, and efforts must be directed to stimulating the formation of additional cell tissue, and thus keeping the health of the tree in a progressively vigorous condition. On the other hand, should the subject of treatment be in a declining state, whether from accidental or natural causes, efforts must be used to arrest the decline, by stimulating the growth of young wood, branchlets, and leaves, so as to aid in the elaboration of sap throughout the head of the tree.

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The causes of what may be styled, for want of a better epithet, "*backwardness*" in large or old trees, are frequently obscure and puzzling. It may arise from many sources, such as exposure to sudden extremes of temperature in spring, chilling the young foliage, and stunting its development to such an extent as seriously to interfere with the leaf functions for the season. The penetration of the rootlets into an ungenial substratum or subsoil, inimical to the further progress of the tree, is another cause of "backwardness" in large trees; and this is one of the most difficult and fruitful sources of mischief with which the arborist has to contend. Defective root action, arising from bad drainage, or from a water-logged state of the young spongioles and rootlets, also frequently tends to incipient stagnation of wood formation and to a hide-bound unhealthy appearance of bark, resulting shortly in a "stag-headed" condition of the upper branchlets. Recently transplanted trees of large size are peculiarly prone to suffer from this last form of "*backwardness*," through the interference with the rootlets in the process of removal and subsequent drought.

One of the first symptoms of a check having been sustained in the continued progressive vigour of any tree, is an appearance of scanty foliage during the summer months along the very top of the upper branches and at their extremities. If this is allowed to go on, in another season these outer and upper branches present a bare, dead appearance, appropriately called "*stag-headedness*," from the resemblance of these denuded branches to the antlers of a deer. Trees in exposed situations are most liable to suffer from this evil, especially if the subsoil be shallow, and of a cold damp nature. The remedy therefore lies in stimulating, by such artificial means as suggest themselves, according to the soil and situation and nature of the tree, the action of its vegetative powers, and the formation of cellular tissue at such extremities of the branches as have become bare and dead like. This will be found to be almost invariably attained by giving the tree, around its trunk and for a space outwards as far as the outer tiers of branches overshadow, a liberal mulching of fresh loam or soil of a friable nature. By such an application to the soil, increased energy is imparted to the more fibrous roots, which are always situated nearest the surface of the ground, and any lack of chemical food-agents in which the site of the tree may be deficient, from long occupation and consequent exhaustion, will be supplied. The application of such fresh soil may be made at any season of the year. Autumn is probably the most advantageous period, and it may consist of road scrapings in a loose, well-turned over, friable con-

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dition, mixed with lime, or applied alone; or of old well decomposed leaf-mould mixed with peat soil; the scourings of ponds or ditches, which have been allowed to dry, and been well turned over and aerated by the frequent use of fork or spade; or, indeed, of any good clean fresh earth of open texture. The surface of the ground about the tree should be lightly forked over previous to its application. The depth to which this compost or top-dressing should be laid, depends upon the situation of the tree to be operated upon, but it should be deposited round the trunk to a depth of not less than two feet (in some cases, when the trunk is exposed at the neck, to a depth of three or four feet), and be gradually tapered off, so as not to offend the eye, from the stem outwards to a final depth, at the extremity of the circumference of the branches, of one foot of fresh soil. In the following season all the dead branchlets in the head of the tree should be cut back to where young wood will have formed, and it is a considerable assistance to the formation of young wood to thin out the head of the tree carefully, by cutting off several of the side shoots springing from the main branches; thus admitting light and air, and promoting a condition favourable to the development of young wood and foliage. In some cases, ash trees, from 60 to 70 feet in height, and growing in strong loam with a clayey subsoil, thus treated after they had shown evident signs of incipient decline, have been known to recover their former vigour. Horse chestnut and lime trees, in the same situation, and from 200 to 250 years of age, have been also successfully treated by the same process, after having been allowed to remain "*stag-headed*" for fully three years. Hollies injured in the memorable winter of 1860–61, and from 20 to 30 feet in height, after presenting an almost dead appearance, were treated in this manner, and the dead branches cut back to the very stem, in some instances leaving almost nothing but the quasi-dead trunk above, and are now fully furnished with dense masses of foliage of the most healthy hue of glossy brightness; and although now lacking the large wide-spread arms, they have been by this treatment *saved*, and their height, as tall evergreens, secured, where absence would have created an unsightly blank. The growth of young wood under this treatment is sometimes so thick that it is necessary, after the first season, to thin it out, removing superfluous shoots, and singling out leading twigs into which the force of the resuscitated action may be directed for the formation and development of new cellular tissue. It may sometimes be necessary, where the natural soil in which the tree is placed is inimical to its habits and nature,

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to use as a compost or top-dressing a mixture of earths of various kinds, and the reverse in their chemical composition, of the soil in which the tree has begun to wane. In cold, clay, damp, or wet tilly soils, for example, in which few hardwoods will thrive for any long time, or acquire large dimensions, it will be found advantageous to use a mixture of coal ashes or wood ashes (the cinders having been removed), compounded with road scrapings (silicious) or well decayed peat, in the proportion of one part of coal ash to three of road scrapings, or mould of peat or decayed leaves. A compost of this description need not be laid on thicker than about one foot at the tree neck, gradually tapering off to about four inches thick at the outer circumference of the circle. It should be applied in autumn, and during the fall of the leaf, and carefully stirred into the soil in which the tree is growing. The use of ashpit refuse from dwelling-houses, from which all cinders have been carefully removed, is not so generally appreciated as it ought to be for the promotion of vigour and healthy foliage in trees. If administered to young specimens, and dug into the soil in which they are intended to be placed, its effects very soon become apparent in the increased root action, and consequent improved health and appearance of the plants.

In cases of large trees whose condition seems to be stationary, although not positively backward, it will be found beneficial to use a top-dressing of rich loam mixed with leaf-mould and police manure, or house coal ashes, in the proportion of one cart of the latter to four or five of the former, and to lay the compost "*barrow thick*" upon the roots under the drip of the branches, without levelling the surface during the first winter. In this way the rains and snows of winter wash in the various chemical agents of which this compound is made up, and carry down to the rootlets fresh supplies of food, along with the quantity of carbonic acid gas derived from the atmosphere; and in this way the powers of exhausted soil in which trees have been too thickly planted are renewed, and the dormant functions of nature in the tree itself receive a revivifying impulse.

The application of police manure or street sweepings as a medium for increasing and intensifying tree life was first suggested by the appearance of several beech trees, of large dimensions, standing in rows in the centre of a field which, after long remaining in pasture, had been broken up for cropping. During the earlier years of the rotation, no difference in the progress or appearance of the beeches was apparent; they had previously exhibited symptoms of decay and *stationary* existence for many years; but one season, after an

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unusually liberal application to the soil of rich well-turned police manure for a turnip crop, the beech trees suddenly appeared to have taken a new start,—a fresh lease of life as it were,—and their unusually strong growths of young wood quite apparent, while the colour of their foliage lost that sickly hue which had for years distinguished them. It seems, therefore, reasonable to suppose that the suddenly increased sap-action in these trees was due to the chemical agency of the ingredients of the police manure in the soil; and it is perhaps worthy of further experiments, whether the stated application of this manure, in well-regulated quantities, according to the individual requirements of special cases, might not be adopted alone, as in the case of the beech trees referred to, as an active stimulant to promote stagnant tree life, and also as a revivifying agency to restore to comparative vigour trees whose waning appearance may have for years suggested gradual decline and approaching death.

To younger specimens, and chiefly to some of the more recently-introduced coniferæ and evergreens, the application of liquid stable or byre manure has long been known, and its use has been in many instances of much benefit. It requires, of course, to be presented in a highly-diluted form, and either in the autumn or winter months after rain, and while the ground is well saturated with moisture. It is of considerable benefit to the progress of *Araucaria imbricata*, and to many of the *Cupressus* and *Juniperus* families. But it requires carefu luse in the case of those pines (*Abies* or *Piceas*), which are of themselves prone to throw out early buds in spring; for any undue stimulant of growth during the cold frosty winds of March or April must be attended with corresponding failure and disappointment. In using liquid manure, therefore, in such cases, it is better to apply it, well diluted, in May than at an earlier or later period of the year. To stimulate such species, either into too early vigorous growth in spring, or to prolong their active vitality into late autumn, and thereby retard the proper ripening of their young wood, is alike a mistake, and necessary to be guarded against.

When, in any particular instance, it is deemed proper to administer diluted liquid manure to cure stagnant energy in tree-life, it must be applied very slowly and gradually. For the principal object in the application of any manure is to supply as much soluble matter as possible to the roots for their absorption into the system of the plant or tree, and if it be administered slowly and gradually, it must necessarily be the more thoroughly assimilated in the gradual formation of sap and the various tissues.

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A mulching of short cut grass has sometimes been found beneficial for top-dressing the soil around and over the roots of choice or rare specimen trees and shurbs, and it has often proved of much advantage to the *Araucaria imbricata*, *Cedrus deodara*, and other newer introductions, in many places, acting not only as a manure, but also as a preventive against evaporation, and as an important agent for retaining the moisture in the soil. Such an application plays a double part, and is worthy of more general adoption than at present is accorded to it. If the covering be neatly laid on, and closely and evenly spread, there is nothing unsightly in this mulching, and it is of very great advantage in many other ways.

Another fertile source of incipient decline, and a means of accelerating decay and death in old trees, is the practice of leaving dead wood, and allowing nature to rid herself, by the intervention of wind or storm, of many a useless dead bare limb or branch, which should have been skilfully removed when death became apparent. The rugged wound which a gale of wind causes in wrenching off dead branches from the heavy limbs of a tree is the source of much ultimate evil. Weather works down into the scar so created, and the dry woody tissues of the stump aid the further spread of decay. Old timber trees should, as regularly as young plantations, be gone over carefully every year, and have all dead or dying big branches and twigs sawn over, the wounds being, at the time, covered with a good coating of strong oil paint.

This leads us to consider the other process of conservation of large trees, referred to in the early part of this paper, viz.,—to the cases of those in which all progressive vigour is beyond recall, but whose picturesque and gnarled trunks or hollow stems, from historical associations or traditionary legend attaching to them, it may be desirable to use every possible means to preserve. The appliances in such cases are mainly mechanical. Painting the shattered wound caused by the livid thunder-bolt, so as to exclude the destructive ravages of the wind and rain; roofing over with zinc or lead the hollow decaying stem of some historical memorial; girding with iron hoop or rod to its parent stem some giant limb, whose swaying form the hurricane has well-nigh wrenched from the old trunk, are remedies too well known and generally practised to call for any notice in this paper. But there is one means for the better protection and supervision of the state of old and historical or remarkable trees throughout Britain, which, we venture to suggest, would do more to call attention to such ancient landmarks and historical fingerposts,

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and secure their conservation, than any other measures of protection yet adopted. We propose that under the auspices of this Society (within whose province it is clear that such a task would not be out of place), as they are the best medium for obtaining the requisite information, a system of registration, or Census of all the old and remarkable trees throughout the country, should be formed. Full particulars as to their position, age, condition, girth, soil, subsoil, and locality, could easily be obtained, along with a reference to any interesting historical events connected with them, from the numerous zealous members of the Society scattered over the various counties and parishes of the country. The information so collected would be tabulated, arranged, and published in the Society's Transactions from time to time, supplemented with any remarks that may be necessary; and if a series of illustrations of the several subjects described could be added, as doubtless might be easily obtained, we should then have a guide-book, and record of one of the most interesting groups of ancient memorials of which the country can boast; and one which, alas, too surely, if left in its present untended and unrecorded condition, must year by year, suffer blanks to occur in its already attenuated ranks. But if the system of conservancy registration now suggested, were adopted and applied to these ancient landmarks, the record would form, for many years to come, one of the proudest achievements, and most useful, interesting, and successful undertakings of the Scottish Arboricultural Society.

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XXVIII.—*On the Use of Steam Power in Forestry.* By D. F. M'KENZIE, Forester, Meldrum House.

The great advantages resulting from the employment of steam power in almost every branch of industry are so generally recognised that it seems out of place to make any prefatory remark. In forestry, however, its application is at present on a very limited scale; but we believe, were it more fully tried, confidence would be gained, and great advantages would follow.

The successful employment of the locomotive engine in aid to forestry depends upon the extent of work contemplated, the condition of the roads in and from the woods, and the distance from market, shipping port, or railway station. It will be apparent that the quantity of wood requiring to be cut must be sufficient to keep the engine in operation all the year round, and this may be one reason why steam power is not more extensively applied, especially in the transit of timber. Yet, on moderately wooded estates, this objection could be got over by causing the same engine to saw the timber and transport it to market, and, in many cases, drag it to the mill side, at a much cheaper rate than by horse power. For this purpose the engine would require to be a road locomotive engine, workable also as a common portable one. However, on estates where the work is very extensive, the employment of two engines would, we think, be more profitable than that of one, as the saw-mill engine might then never require to be moved except from one wood to another, for convenience in carting to the mill, thus saving much labour. The other engine might be always used for the transport of timber, and the same men employed at the same work. The saw-mill engine, if a common portable one, would cost less than a road locomotive of the same power, and, when being moved, it could be drawn by either the road locomotive or by horses. Where the working of two engines is practicable, the proportionate profit will be much greater.

Most of our country roads are quite serviceable for the use of a locomotive of the power described; and in woods, if the soil is hard and tolerably level, a loaded traction engine could travel over it with ease, for the purpose of carting or dragging the felled timber to the saw-mill. As to the distance from shipping port, &c., the distance the engine can go and return in a day is about sixteen miles.

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In clearing old woods for replanting, the locomotive would be of great service, as by its aid the beetle pest could almost be got rid of —by having all the old roots removed immediately after the timber. In this way replanting could be proceeded with much sooner after the removal of the old crop than is usually the case. The tearing up of the roots exposes a large surface of soil to the fertilising influence of the atmosphere, and thus prevents the growth of fungus so common among old roots, and so injurious to young plantations. On estates largely wooded the locomotive engine would in this and other ways forward the forest work in a speedy and profitable manner, even should it not be contemplated to manufacture the wood. When the producer fells, but does not manufacture his wood, the road locomotive could be used for the transport of the rough timber to market, but at least from 15 to 20 per cent. would be lost, and this course would only be advisable when the wood is not suitable for manufacture, as pit wood and common burn wood.

A few years ago we had occasion to clear a large plantation of heavy beech trees. Having found a market for the timber eleven miles distant, and advertised for carters, a number came forward with offers, among others an engine-hirer from the district. On opening the tenders it was found that the engine-hirer was 50 per cent. lower than any of the carters, and he, after paying all expenses, including tear and wear, had 7 per cent. profit.

The large amount of capital required to begin operations is a reason given for the locomotive not being largely used in the transit of timber; but putting steam and horse-power side by side for one year, it will be found, as shown below, that a large balance lies in favour of steam. The following is the cost of an 8-horse power locomotive engine with two waggons, and the probable expense for one year, including one horse and cart—a necessary appendage in forest work:—

8-horse power road locomotive, . .	L.525	0	0
Two waggons to carry 8 tons, . .	144	0	0
Horse, cart, and harness, . . .	85	0	0
Interest on capital, at 4 per cent., . .	30	3	2
Keeping, shoeing, &c., of horse, . .	56	12	0
Driver, ...	40	0	0
Fuel for engine for 313 days, . .	110	0	0
Carry forward,	L.990	15	2

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Brought forward,	L.990	15	2
Engine-driver,	60	0	0
Waggon-man,	50	0	0
Lad to precede engine with flag,	30	0	0
Insurance, tear and wear,	55	0	0
Rent and taxes,	7	0	0
Total,	L.1192	15	2

Cost of an equal amount of horse power—

Nine horses, carts, and harness, at L.85,	L.765	0	0
Interest on capital,	30	12	0
Keeping, shoeing, &c., at L.56, 12s. per horse,	509	8	0
Nine drivers, at L.40 per annum,	360	0	0
Total,	L.1665	0	0
Expense of Steam,	1192	15	2
Balance in favour of Steam,	L.472	4	10

In most cases one driver is sufficient for a pair of horses, but in wood work it is generally found to be more profitable to have a man accompanying each horse; the nature of the roads and loads demands this.

Of course a good deal of the profit derivable from the use of steam instead of horses depends upon the management of the locomotive, especially where one engine would be used for both the sawing and transport of the wood; for however much work the engine might be capable of doing more than horses of equal expense, yet, if clumsily managed, the profit might be reduced to *nil*, if not indeed converted into a loss. Still, the management is simple and easy, and, by proper attention, the employment of steam instead of horses may be turned to great advantage, and become a source of profit and satisfaction to the employer.

The use of the portable steam engine in the manufacture of timber is now common, and its great utility universally admitted. With the exception of water there is no cheaper motive power, and in most cases it is more advantageous to use steam than water, as the engine can be shifted so as to reduce the cartage to the mill to a

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minimum, while the wood requires to be carted to the water saw-mill from however great a distance. This is also the case with stationary engines. If the extent of wood cut down be small, one engine, as already suggested, should be used for both the sawing and cartage. For this purpose the mill should be so constructed that the engine can be easily attached and detached at pleasure, and with a multiplying motion between the engine and saw pulley; as, if the motion is direct, the flywheels of road locomotives generally are too small to drive the saw with sufficient velocity. The common portable engine is usually set on a convenient spot, and worked there as long as the wood around it is within easy cartage to it. With this engine no intermediate motion is required. It may be stated that the situation chosen for the saw-mill should, if possible, be near a constant supply of water, so as to keep the engine supplied, as an 8-horse power engine consumes from 80 to 100 gallons per hour; the quantity of water consumed depending upon the work done. An 8-horse power would work two saws at any ordinary work; but it is convenient to have a cross-cut saw attached to the mill, to be worked at pleasure, either directly from the engine or from the shaft on which the other saws are fixed. Such a mill is suitable for manufacturing wood for both English and Scotch markets. The number of hands required depends upon the nature of the work. One man is required to attend the engine under all cirumstances; and if the mill be cutting staves, for instance, a man and boy at each of the two saws is sufficient—the men to work at the saws, and the boys to remove the backs and staves and convey them to where they are to be built for drying. Though not always necessary, it is often the case that a labourer also is employed for removing the sawn timber and sawdust. When cutting heavy timber it often requires two men at each saw, and a labourer to carry the sawn wood to the drying pile. The wages of the men vary in different localities, but it is most profitable to pay a good price for a good workman of steady habits. At present we pay saw-millers from 20s. to 25s. for sixty hours; engineman, 17s. to 20s. with free house; labourers, 17s.; boys, 9s. to 12s. These men are engaged by the month, and consequently their wages are liable to rise and fall during the year. These figures seem high for this class of work on an estate, but as we carry on the work on *wood merchant* principles, we must pay the same rate for the same class and quantity of work. Our experience in the use of portable steam engines and saw-mills for a period of sixteen years proves to us that they are indispensable in the manufacture of wood; and we

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are persuaded that the use of the road locomotive may be made a source of great gain. To those who give the latter a trial, in a year or two they will be surprised to find the large amount of profit arising from its use in all work connected with forestry to which it is applicable.

In conclusion, a word may be said with regard to the engines themselves. They should always be of the best material, which implies lightness as well as durability. From 6 to 10-horse power are proved to be the most serviceable for all purposes; even on turnpike roads an engine over 10-horse power is cumbersome. Aveling and Porter, Rochester, England, are the best makers of road locomotives; but as we have no experience of their common portable engines, we would recommend those made by Hornsby, Grantham, as being complete in almost every particular.

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XXIX.—*The Advantages of Planting in Groups, or in Mixed Plantations, so as to combine Profit with Landscape Effect.*

By WILLIAM GORRIE, Rait Lodge, Edinburgh.

Were the question merely, whether is grouping or mixed planting most productive of landscape effect? it might be conceded that the unanimous verdict would be in favour of *judicious grouping;* and that on all sizes of landed properties, from the two or three acre villa environs, where groups are necessarily restricted to a few specimens, upwards through increasing sizes of country estates, to the most extensive and varied surfaced demesnes, where they may form masses of tens, twenties, or even hundreds of acres of the same or closely allied kinds. But were grouping only to be deemed admissible on condition of its being equally profitable with mixed or promiscuous planting, I fear that its most strenuous advocates would fail in its defence; more especially were it required that its landscape effects should be maintained unimpaired by other kinds of nurses from the time that the young trees attain to sufficient size for concealing the natural herbage of the ground surface. For, in the first place, there is the additional cost of the young plants; and, secondly, the thinnings will not yield nearly the money returns that would be derived from larch, firs, and other cheap and fast growing nurses. I will return to this subject after making a few remarks on the grouping of trees for landscape effect, under the following heads, viz.,—

1. Soil and situation.
2. Forms and sizes of groups.
3. Grouping with the same and allied kinds.
4. Grouping with different kinds.
5. Grouping with respect to size, form, and colours of leafage.
6. Park clumps, belts, groups, and solitary trees.
7. Avenues.
8. Fences.

1. *Soil and Situation.*—The choice of soils and situations best suited for the healthy development of the different kinds of trees is even more important in ornamental than in economic planting, and as, in the former, the numbers of sorts dealt with is much greater than in the latter, a more widely extended knowledge of arboricultural botany is needed than is usually aspired to by merely practical foresters. Farther, in ornamental planting, a knowledge

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of the wind-resisting powers of the different kinds of trees is specially needful, in order to arrange them so that the stronger may shelter the weaker, and prevent that one-sided appearance that, although prized by artists in depicting wind-beaten scenery, is looked upon by tree admirers with feelings of unpleasantness.

2. *Forms and Sizes of Groups.*—Premising that in group planting the operator should have a clear perception of the appearances that all the kinds of plants operated with will present at the successive stages of their after growth, the forms of groups should be irregular, and without hard or harsh outlines, as exemplified on a large scale by the few native forests that are still left in our country, where, from masses of the Scotch fir on the lower flats and hill sides, flakey-like portions run up irregularly into the more or less sheltered hollows and ravines, skirted and interspersed, where the soil is wettish, with groups of birch, alder, and willows; occasionally under-wooded on drier and rocky parts by patches of the hazel, mountain-ash, bird-cherry, holly, and juniper. It is in planting large extents of hill and mountain slopes that grouping or massing can be carried out to the fullest and most effective extent. And although this may be done successfully with the kinds of trees in ordinary cultivation, it can be far better accomplished by employing a much greater diversity of sorts; commencing near the sea-level with chestnuts, the true planes, walnuts, and other natives of southern Europe, or of like climates, associated with poplars and willows by the water-courses, and succeeded in ascending progression by limes, oaks, cedars, elms, maples, ash, beeches, silver firs, spruces, many of the true pines, and others, the hardier of which fringing extensive masses of the more remunerative larch and Scotch fir, till succeeded in turn by the Cembran and mountain pines, birch, upland willows, and other representatives of the higher regions of tree life. Grouping on a large scale may also be done with good effect in low country flattish-lying plantations that are much overlooked from elevated places, as residences, public roads, railways, &c. But with such plantations it is generally more expedient to restrict the grouping to near and at their outer margins. In plantations on such an extensive scale as here indicated, the most remunerative kinds of trees should of course form the larger masses; but no group should be so small as to be ineffective, or indistinctly noticeable in the general landscape, when viewed from important although somewhat distant points of observation. These remarks, with reasonable modifications, are also applicable to plantations of diminishing extent, down to the villa

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grounds of a few acres; where the outside appearances should not be forgotten, although the views from the house windows, and internal walks may be deemed of more paramount importance. But even here grouping is decidedly preferable to mixed or what may be more correctly termed higgledy-piggledy planting. Where, however, the space to be operated upon is very limited, it is seldom advisable to plant more than one tree or shrub of the same sort, and that should generally be associated or grouped with its marked varieties or kindred species.

3. *Grouping with the same and allied kinds.*—By far the most generally commendable mode of group planting, is that of associating species with their varieties, and others belonging to the same or allied generæ. Here, however, the question of economy would come in with hindering, if not prohibitory effect, were it necessary that all the kinds should be the same or nearly the same in number. But this is by no means the case; for the kindred kinds deemed ultimately to be most remunerative may predominate so far as to produce the desired landscape effect, the others being introduced as side groups of greater or less sizes, proportionate to the original cost of plants, and their ultimate commercial value. All that are intended to be permanent specimens should be allowed plenty of room for their full development; and they should be arranged so that their decreasing heights will show off the taller kinds behind, and bring down the general outline to connect agreeably with the adjoining ground surface. Where allied dwarf grouping kinds will thrive as underwood, they are the most suitable to plant as such, and next to them shrubs with somewhat similar foliage; for nowhere should the undergrowth contrast harshly or unpleasingly with the general mass when viewed from the outside, unless when only of such low heights as to associate with the grass and other natural ground herbage. As an example of regular and hard outline grouping to be avoided, a plantation of fully 50 years standing may be instanced on the steep rugged slopes of Kinnoull Hill, near Perth, where the different kinds were originally grouped in straightish-sided, square, and parallelogram-like fashion, except where some of the outlines are broken into by the bases of the magnificent precipices which form the preponderating features of the hill. Thinning out, and the irregular spreading tops of the reserved trees, have tended in some measure to tone down the rigid straightness of outline which the groups originally presented; but they still and will remain as blots in landscape arboriculture. Another although less objectionable

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example, in which the outlines are more irregular, but not less abrupt and harshly defined, is observable from the decks of Clyde steamers in passing between Roseneath and Kilcreggan, the age of which appears to be between 12 and 15 years.

4. *Grouping with different kinds.*—Trees widely different in their affinities, but having a resemblance to one another in the size and forms of their leaves, may be associated in groups. Mixture of kinds, however, is most commendable when they possess some other marked characteristic in common, such as colour of foliage, bark, and flourish, habit of growth, or form, &c. Thus, when depth or darkness of colour in leafage is desiderated, fit associates exist in the purple beeches, oaks, elms, hazel, barberry, &c. Where light colours are wanted, they are at command in the Corstorphine plane, the golden oak (*Quercus pedunculata, concordia*), golden ash, birch, alder, and elder, as well as in the gold and silver shaded yews, moonlight holly, spruces, and smaller coniferæ; as also among the naturally silvery-foliaged trees, such as the Abele poplar, the Huntingdon, and some other willows; the whitebeam or service tree, sea buckthorn, &c.; while among strictly variegated trees and shrubs there exists a wide field to select from. The autumnal colours and tints of fading foliage deserve marked attention at the hands of planters for ornamental effect. And whether the rich scarlets and purples of our native geans, and of some American oaks, the golden yellow of the Norway maple, or whatever colours are wanted in plants that have been grown from seed, it is a wise precaution to select them in the nursery, when the colours are most marked, as the fading leafage of plants raised from seed is generally much varied, although these be of the same species or kind. Colour in bark is most appreciable when the branches are denuded of their foliage; and small or moderately sized groups, having distinct colours, tend to break up or relieve that dull monotony which prevails in deciduous woodland scenery throughout the winter and early spring. The following may be instanced:—With white or lightish coloured bark—the common and several other kinds of birch, Constantinople hazel, snake-barked maple, the cane or white Welsh willow (*Salix decipiens*), *Cratægus punctata*, and some other hawthorns, &c. With yellow or orange coloured bark—the yellow-barked small and large-leaved limes, golden ash, golden and copper willows, &c. And with reddish, dark, or blackish bark—the red twigged or coral lime; *Salix acutifolia, S. daphnoides, S. purpurea, S. nigra*, and some other willows; *Cratægus M'Nabiana*, and several other hawthorns; the red dog-

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woods, &c. With regard to flourish—although the horse chestnut and the gean are the only full or large sized forest trees that produce showy blossoms, there are of smaller trees the Pavias, and other allies of the former; while, belonging to the same natural order as the latter, there are others of the cherry tribe, hawthorns, services, mountain ashes, mespiluses, almonds, and the wild forms of the apple, pear, and plum. In other families there are the Scotch and English laburnums, robinias, lilacs, elders, &c., which, together with rhododendrons, azaleas, wéigelias, and other flowering shrubs too numerous to mention, are admirably adapted, when grouped according to their colours, for decorating the margin as well as the interior of our woodlands. And on prominent rocky snabs, natural sites for the rowan, the gean, and the sloe-thorn, the snowy whiteness of the last two displayed before the earliest leafage of spring, is ever the admiration of all beholders. Of distinct habited trees, drooping or weeping kinds, which only attain to little above their original height, are very serviceable for shutting out lower and near at hand unsightly objects, without impeding the views of more distant and important scenery. In such a case, weepers being comparatively few, a judicious mixture of kinds becomes necessary in order to obviate disagreeable monotony and uniformity This suggests a procedure that is too generally neglected in opening up views that have become interrupted or shut out by the overgrowth of injudiciously planted trees, viz., that of grafting some of these with weepers at requisite heights, particularly ashes and elms, which are the most easily operated upon: and the more general adoption of this practice would be the means of retaining many a fine stem or bole, where their presence is ornamental as well as needful. Among upright, pyramidal, and conical formed trees, we have the Lombardy poplar as the most important, from the great height to which it attains, as well as from the remarkably fastigiate upright habit of its growth, characteristics which render it highly suitable for certain localities, but most incongruous in others. Thus, when neither too thickly nor over widely grouped at the ends of a bridge, viaduct, or high-level topped embankment, those horizontal lines are, as it were, balanced and supported by the perpendicular lines of the poplars, and the latter have a singularly important landscape effect when seen rising from among ordinary plantations over these horizontal surfaces, as well as over flattish topped ranges of buildings, while, among or rising behind groups of roundish headed trees, their occasional presence has a very pleasing effect. On higher, drier, and more exposed

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grounds, some of the taller growing conical-topped conifers, such as the silver fir, are productive of similar results; but great care is requisite not to introduce either these or the Lombardy poplars over abundantly. In pleasure-grounds, a lower class of fastigiate trees, as well as of shrubs, may be introduced with equally effective results, such as the different upright growing elms, fastigiate oaks, hawthorns, thorn acacia, elders, yews, junipers, cypress, &c.; but neither should they be over abundantly planted.

5. *Grouping with respect to size, colour, and form of Leafage.*—In planting, as in painting, light and dark colours as well as sizes impart apparent nearness or distance when the trees are equally removed from the observer, and this is still more obvious when the leafage is alike or nearly so in form. For example, if a Corstorphine, a common, and a Jersey plum or sycamore are thus equidistant, the light colour of the first will make it seem nearer than the second, while the darker colour of the last will make it appear as if still farther off. In like manner, with the common sycamore, the sugar maple, and the English maple, the diminishing size of the trees as well as of their foliage would seemingly place the first in advance of the second, while the last, from its much smaller as well as darker green foliage, would appear as if considerably beyond. Again, with very dark colours, such as the purple beech, purple elm, and the like, if these are planted equi-distant with common beech and elm, the purple foliaged trees would appear at further off distances proportionate to the depth of their colouring; and these effects are still more marked when such very dark foliaged plants occupy situations that are shaded from the sun at the time of observation, as on the north or east sides of plantations. Deciduous trees retain the foresaid appearance of nearness and distance according to the size of their foliage, even when it has fallen, from its being a general rule that the strength or thickness, as well as the number or quantity of the young shoots or branchlets, is proportionate to the size of the leaves. This is exemplified in our largest leaved trees, the horse chestnut and common plane, with their few and thick shoots, contrasted with the birch, which is at once the smallest leaved and most slenderly as well as closely twigged of ordinary forest trees. One of the seemingly most difficult problems that the landscape forester has to solve is that of making straight lines appear crooked, and stiff ones easy. This, however, is often a very necessary performance, as in the cases of hedge rows and other lines of trees, as well as in straight or stiff outlined belts and planta-

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tions. But it can be often successfully performed by attending to the preceding rules.

6. *Park Belts, Clumps, Groups, and Solitary Trees.*—In the arboricultural decoration of most of the ornamental parks and pleasure-grounds that surround country mansions, there is too much unmeaning sameness and want of design. The outer belts, as well as the interior clumps, are usually planted with unseemly mixtures of overcrowded ordinary kinds of forest trees, rising abruptly to full height from their fence enclosures, without any attempt at rounding or sloping them down so as to associate harmoniously with the surrounding turf, by means of intervening ornamental trees of diminishing stature, and shrubby underwood. Not unfrequently some convenient corner is set apart for conifers or other fashionable novelties so near to the mansion-house, that either it or they will have to be removed before they are half grown. Or, if sufficiently remote from it, they are planted so close to one another, that, to prevent the whole becoming unsightly abortions, the axe will have to be freely applied for thinning ere they are half a century old. Others, it may be, are scattered about at more suitable distances; but with such, a too common fate is injury or destruction from the drip, shade, or wind-falling of too near and much older neighbours. This last remark is not to be taken as recommending the removal of fine old park trees, that may have been favourites with their successive owners for centuries, but is, with the others, designed as an argument against planting choice young trees in like situations, when, in many instances, better accommodation might be had for grouping them in the belts and clumps before mentioned. Park belts and clumps are admirably adapted for grouping trees and underwood in the different manners before described; and detached clumps are specially suited for grouping the different families apart. Thus the oak would form one of the largest and most perfect clump groups; comprising as that genus does not only round and spiry headed trees of the largest sizes, but also many tall as well as dwarf evergreens, and a goodly assortment of low and intermediate growing deciduous kinds, together with a wide diversity in the sizes of their leaves. Compare, for instance, those of the common oak, which are by no means the smallest, with this leaf of *Quercus macrophylla*, brought here by Mr Baxter from Riccarton yesterday, which measures 17 by 7 inches. Clumps of such other families as are deficient in required characteristic particulars might have others of needful forms, colours, &c., tastefully associated with them, both as trees and underwood. Park

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groups of separately fenced trees should only be of select fine growing kinds, and single trees still more particularly so; each group of the former generally consisting of allied varieties, species, or genera. And plants of hawthorn, briars, sloe thorn, furze, &c., growing from at and near the base of some of these singly fenced trees, have a good effect by dispelling that sameness that their bare stems would otherwise present.

7. *Avenues* can scarcely be left without a passing notice when treating of group planting. They may either be straight or curved, and are generally associated with a roadway or a grassy ride; and they may either be composed of two lines, all of one kind of tree; four lines of two kinds or tribes of trees, or what may be termed the arboretum avenue, in either two or four rows, all of distinct sorts, grouped or brought together in families. The first, when intended to form a close gothic arch-like covering, should be planted near to one another in line, and they may be as near to the roadway on each side as half its width. The second or double avenue should generally have the rows next to the roadway or drive of one kind, and the other two rows of a different kind; but full space should be allowed for the after development of every tree, from the ground upwards, without touching one another, encroaching upon the roadway, or concealing from it the trees in the back rows. A very usual and generally commendable practice is to have two corresponding rows deciduous and the other two evergreen trees. The third, or arboretum avenue, is better in four than in two rows, where sufficient space can be devoted to them, as they allow of the dwarf kinds being kept in front and the taller ones behind. And in both the second and third kinds of avenues the back lines may be associated with groups of underwood and shrubbery where adjoined by plantations, and where concealment of, or from the outside is intended. This arrangement is peculiarly suitable for the arboretum avenue, as affording scope for a collection of underwood or small trees and shrubs, as well as of the larger trees. In selecting the kinds of trees for forming the first two described avenues, it is most essential to avoid such as are capricious in their adaptation to any diversity of soils or exposures that may present themselves, so that the greatest possible uniformity of healthy growth may be secured throughout the whole length. And they should, by continuous yet almost imperceptible pinching and pruning, be kept in pleasingly symmetrical forms, so as to prevent the growth of double tops and disproportionately large side branches, that are unsightly in themselves, and become liable to wind breakage as they

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progress in size and age. In regard to the sites or situations of avenues, whether straight or curved, those are best where they do not cut up fine expanses of grassy greenery, or conceal distant interesting scenery,—as by the outer edges of such expanses, through or by the sides of woodlands, and outside of home parks, where approaches have to be carried through arable fields; for which last the foresaid second and third modes are specially adapted.

8. *Fences.*—With reference to plantation fences, it may be remarked that grouping for the purpose of breaking up stiff outlined belts and margins becomes far from effective when these are fenced by obtrusive stone dykes. When the outside of a plantation thus grouped is looked upon over an intervening knoll which conceals its fence dyke, the apparent distance and nearness that is thus imparted to its margin becomes in a great measure dispelled on advancing till the dyke becomes visible. Hedges, and more especially well-kept ones, are liable to the like objections, but in a less degree; and this may be still farther lessened by suiting them to the trees and underwood behind, as by an entire or thickly mixed hedge of the purple leaved barberry, where backed by purple beech, elm, hazel, &c.; by holly, mahonia, evergreen privet, &c., in front of broad leaved evergreens; and by whins, junipers, &c., where backed by small leaved evergreens, such as the coniferæ. Iron fences, except for shelter, are preferable to either of the preceding when sufficiently out from the drip of high trees, to allow of a thick growth of underwood between. But a fence preferable to either, especially for ornamental park groups, clumps, and belts, can be cheaply formed where stones are abundant, by arranging those in irregular rockery-like outline, say 15 to 18 inches high in front, backed alternately by larger ones in four, six, or even more circumjacent unformal layers or lines, with small spaces between, and only a little rise in the ground surface where requisite to supply soil for the free growth of thorny plants, such as the wild and double Scotch roses, in front; sweet and other wild briars, as well as a mixture of the more robust growing garden roses, furze, barberry, junipers, &c., next; then hawthorns, hollies, sloe thorn, and sea buckthorn, the last in dry, bare places, where the others will not grow; the whole being thickened by an undergrowth of mahonias, brambles, Ayrshire roses, honeysuckles, ivy, and other rambling creepers, allowed to grow in natural wildness. This would form an impenetrable as well as a highly picturesque barrier against the inroads of both man and beast, besides being one of the best for game covers; and the interior might

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be fitly occupied by spineless underwood and shrubs, interspersed with strong free growing herbaceous plants, a race far too much neglected in ornamental forestry. The well-known aversion that cattle and sheep have to passing over rough stony surfaces, even when by no means thickly interspersed with thorny vegetation, argues well in favour of this wild-fence notion; and, if fairly tried, it will doubtless be found cheap and effectual, as well as ornamental. As with ordinary hedges it would, of course, require temporary outside fencing.

Returning to the subject of Nurses.—Wherever the landscape effects of group planting are intended to be early and continuous, the nurses employed for sheltering the young permanent plants should be either the same or of the faster growing kinds that assimilate with them in general appearance, for the obvious reasons, that they give the required shelter soonest, and they are the most remunerative as thinnings. For example, the larch as a nurse for the larch; the Scotch fir for itself and other true pines; the common sycamore for its own kind, as well as for others of the Acer family; the Turkey oak for others of its genus; and the ash, in addition to sheltering its own relations, will make a passable nurse for the walnut and others having similarly divided leaves. As a nurse for the silver fir and the darker coloured spruces, the balm of Gilead or balsam fir is especially suitable, from its dying out generally at from 25 to 30 years of age, and thus obviating the tendency that too often exists among woodmen to spare trees after their presence becomes hurtful to their neighbours. When the early effects of group planting are not deemed paramount, the larch will prove a profitable nurse, in situations not calculated for its long enduring healthy existence.

In order to get the greatest number and value of thinnings from a given space, pruning, by shortening or cutting in the side branches of the nurses, so as to prevent them interfering injuriously with the reserves and with one another, as well as for stimulating their upright growth, is a treatment deserving of notice, which was recommended so far back as 1825 by W. Billington, superintendent of planting in the forest of Dean; and in 1841 by the late Gavin Cree of Biggar, whose somewhat different mode has since been very successfully practised on the estate of Sir John M. Nasmyth in Peeblesshire, as well as on that of the Earl of Stair in Midlothian, and elsewhere.

Applying some of the preceding remarks to near-at-hand examples of avenue treatment, you will, on visiting Sir Walter Scott's monument, and the renowned Edinburgh Meadows, have opportunities of

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estimating the arboricultural taste and skill of our city rulers. At the former, you will see avenue trees selected with the utmost disregard to their adaptation for the soil and situation; the kind being the common or Wych elm—one of the most capricious of ordinary forest trees—each with a stem of a few feet, surmounted by a besom-like head of numerous contending branches, as if (should they ever attain to sufficient sizes) for the easy ascent and comfortable accommodation of city roughs when viewing passing processions. At the latter, where, according to R. Maxwell of Arkland, Mr Hope of Rankeillor, commencing about 1722, "raised beautiful hedges and trees, made rich meadows and pleasant walks, where gentlemen and ladies resorted;" and which, in *Campbell's Journey through North Britain*, 1810, are described as "a Mall lamentably unlike St James's, being shamefully neglected avenues, where there was no longer pleasure in wandering among broken down hedge-rows and blasted trees;" a description highly applicable to their management up to the present time, as you will see by their general appearance, and especially by that of the murderously mutilated, ill grown, distorted, unsightly avenue of trees which cuts in two the lengthy expanse of grassy meadow, and regarding which so much has of late been said and written.

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XXX.—*Report on the Meteorological Observations made at Carnwath, Lanarkshire, on the Influence of Forests on Climate, particularly Rainfall.* By ALEXANDER BUCHAN, M.A., F.R.S.E., Secretary of the Scottish Meoteorological Society.

In carrying out this inquiry Mr Maclean of Carnwath very materially assisted the Committee by placing three stations at their disposal. Dr Cleghorn and Mr Buchan visited the three places, and fixed on one which presented conditions of a very favourable character. The forest selected contained about 62 acres, and a little outside, to the north-west, was a green knoll called Gallowhill, quite clear of trees. In the interior of the wood, and 320 yards distant, was another knoll called Winterlaw, of precisely similar character as regards height, exposure, and relation to the ground immediately surrounding it. Immediately on the top of the western slope of this knoll was a bare patch about fifty feet in diameter, which was surrounded on all sides with trees of various sorts, varying from forty to fifty feet in height. The growth of the green sward and of the plants around showed that the situation was well fitted for the inquiry. Two complete sets of meteorological instruments were procured, with proper protection in Stevenson's louvre-boarded boxes, exactly similar to each other. The instruments, consisting of maximum and minumum thermometers, and a hygrometer, were placed—one set on each knoll—at exactly the same height, viz., 4 feet above the ground. The observer, Mr Currie, than whom no better could be named for intelligence, care, and accuracy, began the observations on 16th September 1873, and these were continued till the end of September 1874. The instruments showed the highest and lowest temperature each day, together with the temperature of the air and the temperature of evaporation at 9 A.M. and 9 P.M. The precise points to be elucidated were the conditions of the atmosphere as regards temperature and moisture outside the wood as compared with the interior of the wood. The results of the observations are given in the table accompanying this report, the more important points of which will now be detailed.

Results of the Self-Registering Thermometers.—At Winterlaw, in the interior of the wood, the highest temperature during the period was 79°·4 on 18th July, and the lowest 19°·0 on 11th February

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1874; at Gallowhill, outside the wood, the extremes occurred at the same dates, and were 78°·1 and 19°·8—thus giving an annual range of 60°·4 at Winterlaw, and 58°·3 at Gallowhill.

At Winterlaw the mean of all the maximum temperatures was 52°·2, and of the minimum temperatures 38°·8; these means at Gallowhill being respectively 51°·7 and 38°·7. The means of the night temperatures inside the wood are thus all but identical with those at the station outside; and an examination of the figures of the table will show that they very closely approximated to each other during the whole period. Indeed, if June be excepted, when the difference was 0°·6, the difference did not exceed two-tenths of a degree. On the other hand, the means of the day, or maximum temperatures, show an excess of 0°·5 in favour of Winterlaw. A very remarkable difference is apparent when the months are separately examined. This will appear from the following analysis, in which the plus sign indicates that the mean maxima at Winterlaw exceeded, and the minus sign that they fell short of the corresponding means at Gallowhill:—

September, . .	− 0°·6	April, . . .	+ 1°·1
October, . .	− 0°·5	May, . . .	+ 1°·8
November, . .	0°·0	June, . . .	+ 1°·9
December, . .	+ 0°·3	July, . . .	+ 1°·1
January, . .	+ 0°·1	August, . . .	+ 0°·8
February, . .	− 0°·1	1st to 15th September,	+ 0°·6
March, . .	+ 0°·1	16th to 30th do.	+ 0°·2

The remarkable fact here disclosed is this—During the annual rise of temperature in the spring and summer months, the highest temperature of the day inside the wood was from one to two degrees *higher* than that outside the wood; and during the annual fall of temperature in autumn, the highest temperature of the day inside the wood was on the mean about half a degree *lower* than that outside the wood. If the question was looked at solely with respect to the conservative influence of trees on climate in modifying sudden changes of temperature, a different result might have been expected; in other words, with the general annual rise in the temperature of the air during the spring and summer months, the temperature inside the wood might have been expected to have lagged behind, and with the general fall of temperature in autumn, the temperature inside the wood might have been expected to have fallen less quickly than outside.

The explanation of the facts actually observed is probably this:—

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(1.) Since the thermometers at Winterlaw are placed in the centre of a circular patch, 50 feet in diameter, cleared of trees, it is evident that, considering the comparatively large portion of unobstructed sky overhead, the influence of solar and terrestrial radiation are very considerably felt at the spot where the thermometers are placed. (2.) Since trees from 30 to 40 feet in height surround the thermometers all round, and since the free circulation of the air is thereby greatly impeded, it is further evident that the effects of solar and terrestrial radiation will tend to accumulate at Winterlaw station to a greater degree than at Gallowhill station. For example, on the last six days of June when light winds prevailed (the average velocity of the wind during the period being only 5 miles per hour), with an average sunshine of 8 hours per day the mean maximum temperature of the six days was 62°·9 at Winterlaw, and 62°·0 at Gallowhill. Again, from the 7th to the 13th of the same month, when high winds prevailed (the average velocity for the seven days being 21 miles per hour), with an average sunshine of 10 hours per day, the mean maximum temperature for the period was 61°·1 at Winterlaw, and 59°·0 at Gallowhill. Hence, with very light winds, the temperature of the days was 0°·9 greater in the wood than outside of it; but with high winds the difference amounted to 2°·1. It is scarcely necessary to remark, that it is in very windy weather that the circulation of the air inside the wood is, as compared with what prevails outside the wood in the open fields, relatively least.

During the spring and summer months the great annual increase of temperature takes place, owing to the gain by solar radiation being greatly in excess of the heat lost by terrestrial radiation. Now it is during this period that, as shewn by the Carnwath observations, the day temperature of confined spaces in woods, to which the sun's rays have access, and where circulation is impeded, most exceeds the temperature outside the wood where the circulation is free all round; and it is to be noted that the difference was greatest in June. During the annual fall of the temperature in autumn, the difference between the day temperatures at the two stations is less marked, and besides it is the station inside the wood at which the temperature is lowest,—the mean difference being 0°·6 in September and 0°·5 in October. In September 1873, one of the more marked cases of higher day temperatures at Gallowhill occurred from the 24th to the 27th October 1873, during which period the air remained all but calm, the mean velocity of the wind

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being only 2 miles per hour; the sky all but clear, only one-fifth being covered with clouds; and an average of nine hour's sunshine a day. The means of the observations of the daily maximum were 43°·0 at Gallowhill and 41°·6 at Winterlaw. The heights of the trees surrounding the instruments at Winterlaw, taken in connection with the greater obliquity of the sun's rays in October, are probably sufficient to account for the difference. An examination of the whole observations at both stations at this season shews that the point requires further observation for its elucidation; the question being greatly complicated by the fluctuations of temperature which repeatedly occur in connection with the frequent autumnal storms at this season.

Results of the Dry and Wet Bulb Hygrometer.—The results of the dry-bulbs, giving the temperature of the air, shew that at 9 P.M. the temperature at both stations is very nearly the same during all the months, the difference in no month exceeding two-tenths of a degree, thus shewing a remarkable agreement with the results of the minimum thermometers at both stations.

Equally remarkable is the agreement of the results of the 9 A.M. observations of the dry-bulb thermometer with those of the maximum thermometers at both stations. Comparing the two results, as those of the maximum temperatures were compared, we obtain this result:—

September,	− 0°·	April,	+ 0°·4
October,	− 0°·7	May,	+ 1°·1
November,	0°·0	June,	+ 1°·5
December,	+ 0°·1	July,	+ 0°·6
January,	+ 0°·1	August,	+ 0°·4
February,	− 0°·1	September,	0°·3
March,	+ 0°·2		

Combining the two sets of results, it is seen that during 1873–74 the mean temperatures at 9 P.M. inside and outside the wood, at Carnwath, were practically the same, and remained so, at least, till the time of occurrence of the minimum for the night; that in the spring and early summer months, by 9 A.M. the mean temperature inside the wood had risen higher than that outside, and continued to rise still further above it till the time of occurrence of the daily maximum; and that in autumn, by 9 A.M. the mean temperature inside the wood was lower than that outside, and continued lower till, at least, the time of the daily maximum.

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Dew-point.—The mean dew-point at Winterlaw at 9 A.M. was 42°·5, and at Gallowhill 42°·0, and at 9 P.M. 42°·2 and 42°·0 respectively, thus shewing at both hours, but particularly at 9 A.M., a greater amount of vapour in the air inside than outside the wood. These results, taken in connection with those of the temperature, shew that in the spring and early summer months the air inside the wood is warmer and moister than that outside, but during the fall of the year it is colder and damper. The months during which the excess of vapour in the wood was greatest were September, May, June, July, and August.

It is scarcely necessary to dwell on the importance of these results in their relation to the interspaces in woods which are sheltered more or less from the wind, whether these interspaces be over treeless patches, or over patches of wood where the trees are of less height than those surrounding them. From their obvious connection with the rainfall, the temperature and humidity of the air of these interspaces, which differ so markedly from those of the surrounding air outside the wood, call for fuller investigation, and for this reason the observations made last year at Carnwath should be continued for at least another year.

But other points call for inquiry in carrying out this investigation. (1.) The daily extremes of temperature, and the humidity of the air at a station in the interior of the wood, not cleared of trees as at Winterlaw, but covered with the usual complement of trees; (2.) Underground temperatures at say three depths at the stations of Gallowhall, Winterlaw, and the new proposed station; (3.) The evaporation at the same three stations; and (4.) The temperature of the trees themselves, ascertained by means of thermometers permanently fixed in them, in the manner adopted at the Forest Stations of Bavaria.

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ood of Carnwath, from 16*th September* 1873 *to* 30*th September* 1874.

WIND.										RAIN.	
Number of Days it Blew in Certain Directions.									Mean Velocity in Miles per Hour.	Days.	Amount.
N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.			Inches.
0	0	1	2	3	2	6	1	0	14	6	2·81
2	1	2	0	8	9	6	0	3	11	15	5·78
1	5	5	3	3	5	6	1	1	13	14	2·41
1	0	0	1	7	13	7	1	1	17	17	2·66
1	0	0	1	2	14	13	0	0	19	17	3·21
1	1	2	4	8	7	3	1	1	11	12	1·50
1	1	2	1	4	11	9	2	0	17	13	2·21
1	2	1	3	7	9	6	0	1	16	12	1·77
6	6	10	0	2	2	4	0	1	10	12	1·21
2	3	4	0	3	7	7	4	1	13	7	1·06
0	1	1	2	6	15	5	0	1	10	14	3·05
0	2	2	3	2	10	11	1	0	12	18	5·21
1	0	2	1	7	13	6	0	0	13	17	3·32
17	22	31	19	59	112	83	10	10	14	168	33·39

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APPENDIX (A.)

Scottish Arboricultural Society.

PATRON.

HER MOST GRACIOUS MAJESTY THE QUEEN.

LIST OF MEMBERS

CORRECTED TO AUGUST 1873.

* *Life Members.* † *Members who have given Subscriptions, in order to form a Capital or Sinking Fund.*

All Subscriptions are payable at the Annual General Meeting in November. Members whose Subscriptions are Two Years in Arrear are not entitled to receive the Transactions.

HONORARY MEMBERS.

BALFOUR, John Hutton, M.D., A.M., F.R.SS.L. and E., Professor of Medicine and Botany in the University of Edinburgh.

BULLEN, Robert, Curator of the Botanic Garden, Glasgow.

†HUTCHISON, Robert, F.R.S.E., of Carlowrie, Kirkliston.

LAWSON, George, LL.D., Ph.D., Professor of Natural History and Chemistry, Dalhousie College, Halifax, Nova Scotia.

M'NAB, James, F.B.S.E., Curator of the Royal Botanic Garden, Edinburgh.

†THOMSON, William, Deputy Surveyor, H.M. Chopwell Woods, Burnopfield, Durham.

ORDINARY MEMBERS.

ADIE, Alexander J., Esq., Rockville, Linlithgow.

AIRLIE, The Right Hon. the Earl of, Cortachy Castle, Forfarshire.

AITCHISON, William, Forester, Workington Hall, Cumberland.

ALDER, Robert, Assistant Forester, Dunse Castle, Dunse.

ALEXANDER, James, Nursery and Seedsman, Edinburgh.

ALEXANDER, James, jun., 1 Waterloo Place, Edinburgh.

ALEXANDER, John.

ALEXANDER, John, Assistant Forester, Abernethy, Strathspey.

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ALLAN, Andrew, Rankeillor, Cupar, Fife.
†ALLAN, John, Forester, Dalmeny Park, Edinburgh.
ANDERSON, Alexander, Forester, St Fort, Newport, Dundee.
ANDERSON, Alexander, Assistant Forester, Darnaway Castle, Forres.
ANDERSON, Alexander, Gardener, Oxenford Castle, Dalkeith.
ANDERSON, James, Bangholm Nursery, Edinburgh.
ANDERSON, James, Meadowbank, Uddingston.
ANDERSON, John, Newstead Abbey, Nottingham.
†ANDERSON, John, Nurseryman, Perth.
ANNAND, Charles, Forester, Cromar Estates, Tarland, Aberdeenshire.
ANNANDALE, Robert Burns, The Gardens, Fonthill, Tisbury, Wilts.
ARCHER, James, Assistant Forester, Culzean Castle, Maybole.
ARCHER, John, Assistant Forester, Culzean Castle, Maybole.
†ARCHIBALD, Thomas, Forester, Virginia, Co. Cavan, Ireland.
ARNOTT, Alexander, Hedger, East Wemyss, Fife.
ARNOTT, Robert A., Messrs Sharpe & Co., Seed Merchants, Sleaford, Kent.
ASHDOWN, Samuel Harding, Land Agent, Uppington, Wellington, Salop.
AUSTIN & M'AUSLAN, Messrs, Nursery and Seedsmen, Glasgow.

BAIGRIE, Andrew, Forester, Mote Park, Ballymurry, Co. Roscommon.
BAIGRIE, William, Forester, Echo Bank, Old Dalkeith Road, Edinburgh.
BAILLIE, William, Wood Manager, Cortachy, Kirriemuir.
BAIN, A., Steam Saw Mills, Forres.
BAIN, William, Lochrin Iron and Wire Works, Edinburgh.
BAIRD, Joseph, Assistant Forester, Drumpelier, Coatbridge.
BALDEN, James, Forester, Lennoxlove, Haddington.
BALDEN, Joseph, Assistant Forester, Hawthornden Cottage, Lasswade.
†BALDEN, Peter G., Forester, Vaenol Park, Bangor, North Wales.
†BALDEN, William, Appleby Castle, Appleby.
†BALLANTYNE & SON, Messrs John, Nursery and Seedsmen, Dalkeith.
BALLINGAL, Robert, Factor, Eallabus, Islay.
*BARBOUR, George F., Esq., of Bonskied, Pitlochry, Perthshire.
†BARRIE, David, Forester, Durris, Aberdeen.
†BARRIE, James, Forester, Stevenstone House, Torrington, Devonshire.
BARTER, Frederick, Assistant Gardener.
BATY, David, Forester, Lowther Castle, Penrith.
BATY, William, Forester, Netherby, Longtown.
BAXTER, Robert, Forester, Dalkeith Park, Dalkeith.
†BAYNE, Lewis, Forester, Kinmel Park, St Asaph.
BEGBIE, Harker, Forester, Littledale Hall, by Lancaster.
BEGG, John, jun., Factor, Durris, Kincardineshire.
BELL, James, Strathfieldsaye, Winchfield, Hants.
BELL, James, Forester, Newcastleton, Carlisle.
*BELL, William, Esq., of Gribdae, Kirkcudbright.
BENNETT, Alexander, Forester.

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BERRY, George, Horningsham, Warminster, Wiltshire.
BERRY, Thomas Walter, Forester, Brynkinalt, Chirk, N. Wales.
BIGGE, Matthew, Esq., Islip, Thrupston.
BIRCH, John, Assistant Gardener, Tinnchinch, Enniskerry, Co. Wicklow.
†BIRNIE, John, Normanby Park, Brigg, Lincolnshire.
BISSETT, David, Land-Steward and Forester, Alva House, Stirling.
BISSETT, William S., Land-Steward and Forester, Moncrieffe House, Bridge of Earn, Perthshire.
BLACKLEY, John, Factor, Milton and Castlemilk, Glasgow.
BLAIR, Peter, Dunse.
†BOA, Andrew, Land-Steward, Dalton House, Newcastle-on-Tyne.
BOA, Andrew, jun., Assistant Factor, Blackwood, Lesmahagow.
BOA, James S. M., Agent, Fettercairn, Fettercairn.
†BORTHWICK, William, Forester, Dunnichen, Forfar.
*BOSANQUET, Rev. G. H., Broom-y-Close Court, Llanwarne, Ross, Herefordshire.
BOSTON, Thomas C., Robert Kerr, Nurseryman, Liverpool.
BOTTOMER, Frederick, Gardener, Mackrée Castle, Ballisodare, Sligo.
†BRODIE, James, Land-Steward, Glasslough, Armagh, Ireland.
BROUGH, Robert, Forester, Balnagowan, Tain, Ross-shire.
BROWN, J., Bretby, Burton-on-Trent.
BROWN, James, LL.D., Nurseryman and Wood-Surveyor, Craigmill, Stirling.
BROWN, James, Carnwath House, Carnwath.
BROWN, John E., Craigmill, Stirling.
†BROWN, R. E., F.G.S., Estate Agent, Wass, Oswald Kirk, Yorkshire.
BROWN, William, Land Valuator and Estate Agent (N. America).
BROWN, William, Nursery and Seedsman, Stamford, Lincolnshire.
†BRUCE, Peter, Esq.
BRUCE, The Hon. T. C., 24 Hill Street, Berkeley Square, London, W.
BRUCE, T. R., Esq., of Slogarie, Lauriestown, Castle-Douglas.
BRYAN, F. G. D., Factor, Drumpellier, Coatbridge.
BUCHAN, George, Forester, Bakewell, Derbyshire.
BUCHANAN, Robert, Forester, Dunse Castle, Dunse.
BUIST, Matthew, Factor, Tynninghame, Prestonkirk.
BURNETT, James, Assistant Forester, Durris, Aberdeenshire.
BURNS, Alexander, Hedger, Glamis Castle, Glamis, Forfarshire.
BUSSENS, William, Stow Hall, Downham, Norfolk.

CALDER, Frederick, Forester, Brucklay Castle, Aberdeenshire.
CALDER, R. M., Agent, Myton Hall, Borobridge, York.
CALLOGHIN, John, Assistant Forester, Houston, Paisley.
CAMERON, Alexander, Forester, Countlich Lodge, Ballinluig, Perthshire.
CAMERON, Angus, Assistant Forester, Altyre, Forres.
CAMERON, Henry, Assistant Forester, Dupplin Castle, Perth.
CAMERON, Hugh, Assistant Forester, Novar, Evanton, Ross-shire.

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†Cameron, John, Assistant Forester, Fowlis Wester, Crieff, Perthshire.
Cameron, Robert, Forester, Galtie Castle, Mitchelstown, Co. Tipperary.
Campbell, Alexander, Forester, Gray House, Liff, Dundee.
†Campbell, James, Esq., of Tillichewan Castle, Dumbartonshire.
Campbell, John, Forester, Aboyne Castle, Aberdeenshire.
Campbell, Peter, Assistant Forester, Invereshie, Kingussie.
Cairnduff, Andrew, Forester, Abbeyleix, Queen's Co., Ireland.
Carmichael, John, The Gardens, Glen Tulchan, The Cairnies, Perth.
Chalmers, James, Duchal, Port-Glasgow.
Chambers, William, Esq., Haford, Aberystwith, Wales.
Chaplain, George, Assistant Forester, Glamis Castle, Glamis, Forfarshire.
Chapman, James, Assistant Forester, Grinkle Park, Saltburn-by-the-Sea, Yorkshire.
Chapplow, John, Glencoin Cottage, Patterdale, Penrith.
Christie, David, Forester, Abington House, Lanarkshire.
†Churnside, Francis, Forester, Ladykirk, Berwickshire.
Churnside, Robert, Forester, Capheaton, Newcastle-on-Tyne.
Clark, David, Assistant Forester, Ury House, Stonehaven.
Clark, James, Forester, Balvaird, Fife.
Clark, John, The Nurseries, Cupar, Fife.
†Clark, John, jun., Forester, Esslemont, Ellon, Aberdeenshire.
†Clark, J., Forester to the Earl of Kintore, Keith Hall, Aberdeenshire.
Clark, Thomas, St Andrew's, Miltown, Dublin.
*Cleghorn, Hugh, M.D., of Stravithy, St Andrews, Fife (*Prsideent*).
†Cleghorn, William, Forester, Ayton Castle, Ayton.
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Scott, Walter, Forester, Oxnam, Jedburgh.
Seaton, Allan, Assistant Forester, Cawdor Castle, Nairn.
Service, George, Assistant Forester, Dunse Castle, Dunse.
Service, James, Assistant Forester, Dunse Castle, Dunse.
Shand, James, Gardener, Meldrum House, Aberdeenshire.
Shanks, John, Forester, Kildrummy Castle, by Mosset.
Sheppard, John, Tweedside Cottage, Roehampton, Surrey.
Sim, William, Nurseryman, Forres.
†Simpson, J., Forester, Alloa Park, Alloa.
Simpson, Peter, Assistant Forester, Daughty Mill, Kirkcaldy.
†Simpson, Thomas, Forester, Glenferness, Nairnshire.
Sinton, David, Assistant Forester, Charlton, Malmesbury, Wilts.
Sinton, J., Stourton, Bath.
Sinton, John, Forester, Charlton, Malmesbury, Wilts.
Skeldon, John, Assistant Forester, Dunse Castle, Dunse.
Skirving, Archibald, Forester, Duncombe Park, Helmsley, York.
Skirving, William, Nursery and Seedsman, Liverpool.
†Slater, Andrew, Forester, Lofthouse, Saltburn-by-the-Sea, Yorkshire.
Slater, Andrew, jun., Assistant Forester, Aske, Richmond, Yorkshire.
†Smart, A. H.
Smith, A., Factor, Douglas Castle, Lanarkshire.
†Smith, James, Forester, Donibristle, Aberdour, Fife.
Smith, James, The Gardens, Exton Park, Oakham, Leicestershire.
Smith, John Crombie, Assistant Forester, Drummond Castle, Crieff.
Smith, Thomas, Nurseryman, Stranraer.
Smith, W. Baxter, Messrs Little & Ballantyne, Nursery and Seedsmen, Carlisle.
Smith & Simons, Messrs, Nursery and Seedsmen, Howard St., Glasgow.
†Smith & Son, Messrs William, Nurserymen, Aberdeen.
Solly, Professor Edward, F.R.S., Parkstone, near Poole.
Somerville, Samuel, M.D., F.R.C.P., 17 Hart Street, Edinburgh.
Spence, Charles, Assistant Forester, Drumpellier, Coatbridge.
Stalker, Donald, Assistant Forester.
Stapylton, Major, Myton Hall, Borobridge, Yorkshire.
Stark, Robert M., 21 Verulam Terrace, Hammersmith, London, W.
Steele, David, Forester, Skene House, Aberdeen.

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STEVENSON, David, Forester, Hawkhead, Paisley.
†STEVENSON, James, Forester, Cobham Park, Surrey.
STEWART, Alexander, Chancelot House, Ferry Road, Edinburgh.
STEWART, Alexander, Forester, Grinkle Park, Saltburn-by-the-Sea, Yorkshire.
STEWART, D., Manager, Dalnarert, Aviemore.
STEWART, James, Assistant Forester, Drumpellier, Coatbridge.
STEWART, John, Forester, Blair Athole, Perthshire.
STEWART, John, Assistant Forester, Cawdor Castle, Nairn.
STEWART, J. Lindsay, M.D., Conservator of Forests, Punjaub, India.
STEWART, Peter, Gardener and Forester, Castle Wellan, Co. Down.
STEWART, William, Land Steward, Dalhousie Castle, Lasswade.
STEWART, William, Nurseryman, Dundee.
STEWART, William, Assistant Forester, Underley Hall, Kirkby.
STEWART, William, Assistant Forester, Logie Almond, Perth.
STRANG, William, Assistant Forester, New Scone, Perth.
STUART, John, Forester, Castle Grant, Strathspey.
†STUART, Lewis A. G., Forester, Nethesdale House, Turriff.
STUART, William, Forester.
STUART & MEIN, Messrs, Nurserymen, Kelso.
SUTTIE, James, Evington, Ashford, Kent.
SWAN, R. G., Auctioneer, Dunse.
SYME, David, 1 George IV. Bridge, Edinburgh.—*Auditor.*
SYMON, John, Forester, Cawdor Castle, Nairn.
SYMON, Peter, Forester, Forres.

TAIT, David, Forester, Owston Park, Doncaster, Yorkshire.
TAIT, Walter, Seedsman, 45 Chapel Street, Dublin.
†TALBERT, Peter, Forester, Glenericht, Blairgowrie.
TAYLOR, David, Barskimming, Mauchline.
TAYLOR, George, Forester, Monymusk, Aberdeenshire.
TAYLOR, George, Nursery and Seedsman, Inverurie.
THOMSON, James Scott, Castle Strathallan, Auchterarder.
*†THOMSON, John Grant, Wood Manager, Grantown, Strathspey.
THOMSON, Lockhart, Esq., 22 Coates Crescent, Edinburgh.
THOMSON, Thomas, Forester, Penicuik House, Penicuik.
THORNTON, Thomas, Heatherside, Frimley, Surrey.
TIVENDALE, William, Forester, Houston, near Paisley.
TOMLINSON, J., Brocklesby Park, Ulceby.
TOMLINSON, Wilson, Assistant Forester, Belvoir Castle, Grantham.
TROTTER, Colonel R. A., The Bush, Edinburgh.
TURNBULL, James, Nurseryman, Hawick.
TURNBULL, R. E., West Mount, York.
TURNBULL, William, Assistant Forester, Bowmont Forest, Kelso.
TURNER, James, Assistant Gardener, Dalkeith Park, Dalkeith.

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TWEEDIE, John, Forester, Dunglass, Cockburnspath, Berwickshire.

*URQUHART, B. C., Esq., of Meldrum, Aberdeenshire.

VEITCH, John, Nurseryman, Falkirk.
VEITCH, William, Hedger, Arniston, Gorebridge.

WADDINGTON, David, Crosshouse, Airdrie.
WADDS, Philip, Gardener, Moore Abbey, Co. Kildare.
WALKER, William, Assistant Forester, Penicuik House, Penicuik.
WALL, G. Y., jun., Esq., Exchequer Office, Durham.
WALLACE, Andrew, Assistant Forester, Drumpellier, Coatbridge.
WALLACE, ——, Forester, Panmure, Carnoustie.
†WARD, James, Forester, Hawkhead Abbey, Paisley.
WATERER, Anthony, Nurseryman, Knaphill, Surrey.
WATERS, Denis, Forester, Kelburn Castle, Largs.
WATERSON, A., Assistant Forester, Penrhyn Castle, Bangor, N. Wales.
WATSON, John, The Gardens, Stravithy, St Andrews.
WATSON, William, Assistant Forester, Peth, Longtown, Cumberland.
WATSON, W. J., Nursery and Seedsman, Newcastle-on-Tyne.
WATT, James, Messrs Little and Ballantyne, Nurserymen, Carlisle.
WATT, William, Forester, Nisbet House, Dunse.
*WAVENEY, Lord, Flixton Hall, Bungay, Suffolk.
WEAVER, James, Forester to the Marquis of Lothian, Mount Teviot, Jedburgh.
†WEAVER, James V., Forester, Mount Teviot, Jedburgh.
WEBSTER, David, Bangholm, Edinburgh.
WEBSTER, J., The Gardens, Gordon Castle, Fochabers.
WELSH, Duncan, Gardener, Mount Merrion, Dublin.
†WELSH, James, Nursery and Seedsman, Edinburgh.
†WELSH, William M., Nursery and Seedsman, Edinburgh.
WEMYSS, Randolph Gordon Erskine, Esq., of Wemyss and Torry, Fife.
WEST, Charles Elis, Land Steward, Cartoon, Maynooth.
WHILLIS, Alexander, Assistant Forester, Penicuik House, Penicuik.
WHITE, George, Seedsman, Paisley.
†WHITEFORD, Robert, Assistant Hedger, Bute Estate, Rothesay.
WHYTE, David, Assistant Forester, Dunse Castle, Dunse.
*WILD, A. E., Assistant Conservator of Forests, Punjab, India (6 George Street, Sheffield).
WILLIAMS, B. S., Paradise Nursery, Upper Holloway, London, N.
WILSON, John, F.R.S.E., Professor of Agriculture, University of Edinburgh.
WILSON, John, Forester, Knowefield Nurseries, Carlisle.
WILSON, John, Forester, Auchendolly, Castle-Douglas.
WILSON, John, Assistant Forester, Arniston, Gorebridge.

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WILSON, John, Assistant Forester, Penicuik House, Penicuik.
WILSON, Peter, Forester, Whitehill, Lasswade.
†WILSON, Robert, Forester, Pewsey, Wilts.
WILSON, Stephen, 132 Union Street, Aberdeen.
WOOD, James, Factor, Haighall, Lancashire.
WOOD, John, Gardener, Hatton Castle, Aberdeenshire.
WYLIE, James, Assistant Forester, Douglaston, Milngavie, Glasgow.
†WYLLIE, George, Estate Overseer, Ballogie, Aboyne.

YELLOWLEES, George, Wood Merchant, Galashiels.
YOUNG, John, Messrs Imrie & Son's Nurseries, Ayr.
YOUNG, William, Assistant Secretary, Royal Caledonian Horticultural Society, 33 South Bridge, Edinburgh.

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SUBJECTS OFFERED FOR COMPETITION DURING 1872-73.

I. For the best and approved Report on the most extensive, complete, and judiciously arranged Arboretum. 1st Prize, the "Lawson Prize" of Five Guineas; 2d Prize, a Medal.

The arboretums reported on in 1872 are excluded.

II. For the best and approved Essay on the present state and future prospects of Arboriculture in the county in which the competitor resides. 1st Prize, Five Guineas (offered by David Mitchell, Esq., Nurseryman, Edinburgh); 2d Prize, a Medal.

III. For the best and approved Essay on the literature of Scottish Arboriculture. 1st Prize, Three Guineas (offered by the President); 2d Prize, a Medal.

IV. For a full and complete, but succinct and well-written account, from published descriptions,—with authorities distinctly quoted,—personal observation, and experiment of the history and present state of the cultivation in Great Britain and Ireland of *Cedrus Deodara* (*C. Libanotis*, and *C. atlantica*, all now classed as one species). Special Medal, value Three Guineas (offered by Dr J. Lindsay Stewart, Conservator of Forests, Punjab); 2d Prize, a medal.

V. For the best and approved collection of Cones exhibited from and grown in the county in which the competitor resides. 1st Prize, Five Guineas (offered by Messrs Thomas Methven and Sons, Nursery and Seedsmen, Edinburgh); 2d Prize, a Medal.

The prize collection to become the property of the Society.

VI. For the best and approved collection of prepared sections of different kinds of Wood grown in the county in which the competitor resides. (*A Medal.*)

VII. For the best and approved series of geological specimens illustrating the different rocks and formations on which Forest Trees and Shrubs grow in the county in which the competitor resides. The specimens to be accompanied by a Report. (*A Medal.*)

VIII. On the employment of Locomotive Engines in Forestry, especially for the transit of timber, and on the working of portable saw-mills. (*A Medal.*)

IX. For an approved Report on the Plantations of which the Competitor is Forester. (*Three Medals.*) One to be awarded for

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the best Report from each of the countries—England, Scotland, and Ireland—and competition to be confined to each country respectively.

X. For an approved Report on the management of Forests in Germany, France, and other places on the Continent. (*A Medal.*)

XI. For an approved Report on the different Ages at which the various sorts of Timber Trees usually grown in Scotland may be most profitably felled in different soils and situations. (*A Medal.*)

XII. For an approved Report on the Diseases most incidental to Forest Trees, including those that affect the roots as well as the bark, branches, and foliage. (Limited to Assistant Foresters and Working Woodmen.) 1st Prize, a Medal; 2d Prize (offered by Mr R. E. Brown), copy of "Brown's Forester."

XIII. For an approved Report on the results obtained by experience of Seedlings of Coniferæ, being the produce of trees grown in Britain, as compared with plants obtained from foreign-ripened seed. (*A Medal.*)

XIV. For an approved Report on the natural history of Beetles and other insects which affect Coniferæ—their modes of operation upon the tree, and suggestions as to a remedy for their attack. (*A Medal.*)

XV. For an approved Report on the comparative advantages of the different methods of Pruning. (*A Medal.*)

XVI. For an approved Report on the different modes of profitably disposing of Home-grown Timber. (*A Medal.*)

XVII. To any Member of the Society who shall send to the Secretary from abroad, cones or seeds of Forest Trees of new or rare varieties capable of germination and of thriving in this country. (*A Medal.*)

XVIII. For an approved Essay or Report on any other subject connected with Arboriculture. (*A Medal.*)

XIX. For any marked advantageous improvement on any of the Implements used in Forestry. (Models or Implements to be accompanied by a Report.) (*A Medal.*)

For conditions of Competition, see *Proceedings* of Annual General Meeting of 6th November 1872.

All Essays, Reports, and Implements intended for Competition must be given in to the Secretary not later than 25th September 1873 *—each bearing a motto, and being accompanied by a separate sealed envelope bearing the same motto outside, and containing a card with the motto, name, and address of the Competitor.*

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Abstract of the Laws of the Scottish Arboricultural Society, as amended to 6th November 1872:—

The object of the Society shall be the promotion of the science of Arboriculture in all its branches, by periodical meetings of the Members for the reading of Papers; by offering Prizes for Essays and Reports on the Practical Operations of Forestry, and publication of the same; and by such other means as may be found advisable.

The Society shall consist of the following classes of Members:—1. Proprietors, Factors, Nurserymen, and others, paying an annual subscription of Half-a-Guinea; 2. Head-Foresters, and others, paying an annual subscription of Five Shillings; 3. Assistant Foresters, paying an annual subscription of Three Shillings.

Any Member may become a Life-Member by compounding for his annual subscriptions by a single payment—those of the First Class paying Five Guineas; and those of the Second and Third Classes, Three Guineas.

The Society shall elect a limited number of Honorary Members,—gentlemen who have acquired eminence in the science of Arboriculture, or who are otherwise deemed worthy.

All annual Subscriptions shall be payable in advance, at the Annual General Meeting in November.

In addition to the annual subscriptions above stipulated, the Society shall receive, from those friendly to its objects, Donations of larger or smaller amount.

A Candidate for admission into the Society must be recommended by at least one Member, and shall, on payment of his annual subscription, be immediately admitted a Member of the Society, subject to the revision of the first General Meeting thereafter. Any Member of the Society introducing a New Member shall be held responsible for the first year's subscription of such party.

The affairs of the Society shall be conducted by a President, five Vice-Presidents, Secretary, Treasurer, Auditor, and a Committee of fifteen Members,—these office-bearers to be elected annually at the General Meeting in November; the three Members of Committee at the top of the list to go out annually, but one to be eligible for re-election.

A General Meeting of the Members shall be held on the first Wednesday of November annually, for the election of New Members, the appointment of Office-Bearers, the reading of Papers, awarding of Prizes, and other business.

JOHN SADLER,
Secretary.

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OFFICE-BEARERS FOR 1872-73.

PRESIDENT.

HUGH CLEGHORN, of Stravithy, M.D., F.R.S.E.

VICE-PRESIDENTS.

JOHN HUTTON BALFOUR, M.D., F.R.S., Professor of Medicine and Botany in the University, Edinburgh.
WILLIAM M'CORQUODALE, Forester, Scone Palace, Perth.
JOHN GRANT THOMSON, Wood Manager, Grantown, Strathspey.
ROBERT HUTCHISON, Esq., of Carlowrie, F.R.S.E.
WELLWOOD H. MAXWELL, Esq., of Munches, M.P.

SECRETARY.

JOHN SADLER, F.R.Ph.S., Lecturer on Botany in the Royal High School, and Assistant to the Professor of Botany in the University of Edinburgh.

TREASURER.

THOMAS METHVEN, of Messrs T. Methven and Sons, Nursery and Seedsmen, 15 Princes Street, Edinburgh.

AUDITOR.

DAVID SYME, 19 George IV. Bridge, Edinburgh.

COUNCIL.

CHARLES S. FRANCE, Overseer, Penicuik House, Penicuik.
ANDREW RUTHERFORD, Forester, Bowmont Forest, Kelso.
R. T. MACKINTOSH, Nursery and Seedsman, Edinburgh.
JOHN ANDERSON, Nurseryman, Perth.
GEORGE REID, Nursery and Seedsman, Aberdeen.
ROBERT BROUGH, Forester, Balnagowan, Ross-shire.
JOHN M'LAREN, Forester, Hopetoun, South Queensferry.
HUGH FRASER, Stanwell Nursery, Edinburgh.
DAVID MITCHELL, Bangholm House, Edinburgh.
ROBERT FOULIS, Forester, Fordel, Fife.
JOHN M'GREGOR, Forester, Ladywell, Dunkeld.
WILLIAM GILCHRIST, Forester, Cluny Castle, Aberdeen.
ALEXANDER RICHARDSON, Land Steward, Arniston, Gorebridge.
JAMES MOFFAT, Forester, Newbattle Abbey, Dalkeith.
JAMES SMITH, Forester, Donibristle, Fife.

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APPENDIX B.

GENERAL ABSTRACT OF THE ACCOUNTS

OF THE SCOTTISH ARBORICULTURAL SOCIETY

for the Year ending 5th November 1872.

CHARGE.

To Balance in Bank,	£9	9	11
,, Annual Subscriptions for 1871–2,	59	18	0
,, Arrears,	5	18	6
,, Subscription to Sinking Fund,	0	3	0
,, Life Membership Subscriptions,	26	5	0
,, Robert Hutchison, Esq. of Carlowrie (Donation),	6	10	0
,, Peter Lawson & Sons (Donation)	5	5	0
,, Thomas Methven & Sons (Prize),	5	5	0
,, C. Y. Michie (Donation),	0	12	0
,, Copies of Transactions Sold,	0	6	0
,, Received for Advertising in Transactions, per Keith & Co.,	13	0	0
,, Interest,	0	8	2
	£133	0	7

DISCHARGE.

By Balance from last Account,	£2	6	5
,, Neill & Co., for Printing,	49	6	0
,, Mould & Tod, for Receipt Books,	0	18	6
,, Secretary's Salary,	20	0	0
,, Paid for Prizes, Medals, &c.,	19	13	0
,, Paid over to Sinking Fund Account,	11	15	0
,, Annual Dinner, Extra Expenses,	2	1	6
,, Postages, &c., per Secretary,	10	10	7
,, ,, per Treasurer,	2	5	1
,, Advertising, Stationery, &c.,	2	14	2
,, Balance in Bank,	4	3	1
,, Balance on hand,	7	7	3
	£133	0	7

CAPITAL OR SINKING FUND ACCOUNT.

CHARGE.

To Donation and Life Membership Subscription,	£11	15	0
,, Interest,	0	2	2
	£11	17	2

DISCHARGE.

By Balance in Bank,	11	17	2
	£11	17	2

I have examined the State of the Affairs of the Scottish Arboricultural Society for the year ending 5th November 1872, comparing the same with the books and necessary vouchers, all of which I find to be correct, leaving balance in bank in connection with General Account, Four pounds three shillings and one penny, and owing by Treasurer Seven pounds seven shillings and threepence, being in all to the credit of the Society, besides unpaid subscriptions, the sum of Eleven pounds two shillings and fourpence sterling, and showing a balance in bank to the credit of the Capital or Sinking Fund, the sum of Eleven pounds seventeen shillings and twopence sterling.

EDINBURGH, *5th November* 1872. DAVID SYME, *Auditor.*

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GENERAL ABSTRACT OF THE ACCOUNTS

OF THE SCOTTISH ARBORICULTURAL SOCIETY

for the Year ending 4th November 1873.

CHARGE.

To Balance in Bank,	£4	3	1
,, ,, on hand,	7	7	3
,, Robert Hutchison, Esq. of Carlowrie (Special Prize),	5	5	0
,, Peter Lawson & Son (Special Prize),	5	5	0
,, Admission to Exhibition of Woods,	0	13	0
,, Transactions Sold,	2	19	5
,, Coniferous Seeds Sold,	2	0	0
,, Annual Subscriptions for 1872-3,	84	15	6
,, Arrears,	5	10	0
,, Life Membership Subscriptions,	42	0	0
,, Sinking Fund,	0	8	0
,, Interest,	1	3	0
,, Balance due, National Bank,	25	15	11
	£187	5	2

DISCHARGE.

By Expenses connected with Exhibition of Woods,	£11	9	4
,, Paid for Medals and Prizes,	31	6	6
,, Advertising, Stationery, &c.,	7	6	1
,, Neill & Co., for Printing,	60	0	0
,, Secretary's Salary,	20	0	0
,, Postages, &c.,	12	18	3
,, Paid over to Capital Account,	36	15	0
,, Balance on hand,	7	10	0
	£187	5	2

CAPITAL OR SINKING FUND ACCOUNT.

CHARGE.

To Balance from last Account,	£11	17	2
,, Paid over from Ordinary Account,	36	15	0
,, Interest,	0	5	7
	£48	17	9

DISCHARGE.

By Deposit Receipt with National Bank,	£48	17	9
	£48	17	9

I hereby certify that I have examined the above Statement of Affairs of the Scottish Arboricultural Society for the year ending this day, along with the necessary vouchers, and find the same correct, showing on the General Account a balance in Treasurer's hands of Seven pounds ten shillings (from which the sum of £5, 13s. falls to be transferred to the Capital Account), and balance due to the National Bank of Twenty-five pounds fifteen shillings and elevenpence; also find in the Capital Account the sum of Forty-eight pounds seven shillings and ninepence sterling, lodged with the National Bank on deposit receipt.

Edinburgh, 4th November 1873. DAVID SYME, *Auditor.*

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Scottish Arboricultural Society.

PATRON.

HER MOST GRACIOUS MAJESTY THE QUEEN.

LIST OF MEMBERS

CORRECTED TO AUGUST 1874.

** Members who have given Subscriptions, in order to form a Capital or Sinking Fund.*

All Subscriptions are payable at the Annual General Meeting in November. Members whose Subscriptions are Two Years in Arrears are not entitled to receive the Transactions.

HONORARY MEMBERS.

BALFOUR, John Hutton, M.D., A.M., F.R.SS.L. and E., Professor of Medicine and Botany in the University of Edinburgh.

BRANDIS, Dietrich, Ph.D., Inspector-General of Forests to the Government of India.

BULLEN, Robert, Curator of the Botanic Garden, Glasgow.

*HUTCHISON, Robert, F.R.S.E., of Carlowrie, Kirkliston.

LAWSON, George, LL.D., Ph.D., Professor of Natural History and Chemistry, Dalhousie College, Halifax, Nova Scotia.

M'NAB, James, F.B.S.E., Curator of the Royal Botanic Garden, Edinburgh.

*THOMSON, William, Deputy Surveyor, H.M. Chopwell Woods, Burnopfield, Durham.

LIFE MEMBERS.

ADAM, The Right Hon. W. P., of Blairadam, Kinross-shire, M.P.

BARBOUR, George F., of Bonskied, Pitlochry, Perthshire.

BELL, William, of Gribdae, Kirkcudbright.

BOSANQUET, Rev. G. H., Broom-y-Close Court, Llanwarne, Ross, Herefordshire.

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BRUCE, Hon. T. C., 24 Hill Street, Berkeley Square, London, W.
CLEGHORN, Hugh, M.D., F.R.S.E., of Stravithy, St Andrews, Fife (*President*).
CRAWFORD, William Stirling, of Milton, Glasgow.
DEWAR, Colonel A., of Vogrie, Ford.
DUNCAN, Alexander, of Knossington Grange, Oakham, Leicestershire.
DUNDAS, Robert, of Arniston, Gorebridge.
FISH, D. T., Hardwick, Bury-St-Edmunds.
*GOUGH, William, Wood Manager, Wykeham, York.
GRANTHAM, George, Barcombe Place, Lewes, Sussex.
GRIMMOND, Alexander D., of Glenericht, Blairgowrie.
HOPE, H. W., of Luffness, Drem.
HUTH, Louis, of Possingworth, Hawkhurst, Sussex.
KINNEAR, William Balfour, Foo-Chow, China.
LESLIE, Charles P., of Castle Leslie, Glasslough, Ireland.
M'GREGOR, John, Ladywell, Dunkeld, Perthshire.
MACKENZIE, Colin J., of Portmore, Eddleston, Peebles.
M'TIER, Alexander Walker, of Durris, Aberdeenshire.
MAXWELL, Wellwood H., of Munches, Dalbeattie.
*METHVEN, Thomas, Nursery and Seedsman, 15 Princes Street, Edinburgh (*Treasurer*).
MINTO, The Right Hon. the Earl of, Minto House, Hawick.
MOORE, Thomas, F.L.S., Curator, Botanic Garden, Chelsea.
PORTSMOUTH, The Right Hon. the Earl of, Eggesford, North Devon.
ROSEBERY, The Right Hon. the Earl of, Dalmeny Park, Edinburgh.
ROSSLYN, The Right Hon. the Earl of, Dysart House, Fife.
STAIR, The Right Hon. the Earl of, Lochinch, Castle Kennedy, Wigtownshire.
*TALBERT, Peter, Forester, Glenericht, Blairgowrie.
*THOMSON, John Grant, Wood Manager, Grantown, Strathspey.
TROTTER, Colonel, R.A., The Bush, Edinburgh.
URQUHART, B. C., of Meldrum, Aberdeenshire.
WAVENEY, Lord, Flixton Hall, Bungay, Suffolk.
WEMYSS, Randolph Gordon Erskine, of Wemyss and Torry, Fife.
WILD, A. E., Assistant Conservator of Forests, Punjaub, India (6 George Street, Sheffield).
WILSON, John, F.R.S.E., Professor of Agriculture, University, Edinburgh.

ORDINARY MEMBERS.

ADIE, Alexander J., Rockville, Linlithgow.
AIRLIE, The Right Hon. the Earl of, Cortachy Castle, Forfarshire.
AITCHISON, William, Forester, Workington Hall, Cumberland.
ALDER, Robert, Assistant Forester, Dunse Castle, Dunse.
ALEXANDER, James, Nursery and Seedsman, Edinburgh.

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ALEXANDER, James, jun., 1 Waterloo Place, Edinburgh.
ALEXANDER, John.
ALEXANDER, John, Assistant Forester, Benmore House, Greenock.
ALEXANDER, William, Assistant Forester, Abernethy, Strathspey.
ALLAN, Andrew, Rankeillor, Cupar, Fife.
*ALLAN, John, Forester, Dalmeny Park, Edinburgh.
ANDERSON, Alexander, Forester, St Fort, Newport, Dundee.
ANDERSON, Alexander, Assistant Forester, Darnaway Castle, Forres.
ANDERSON, Alexander, Gardener, Oxenford Castle, Dalkeith.
ANDERSON, Hugh, Assistant Forester, Hawkhead, Paisley.
ANDERSON, James, Bangholm Nursery, Edinburgh.
ANDERSON, James, Meadowbank, Uddingston.
ANDERSON, John, Newstead Abbey, Nottingham.
*ANDERSON, John, Nurseryman, Perth.
ANNAND, Charles, Forester, Cromar Estates, Tarland, Aberdeenshire.
ANNANDALE, Robert Burns, The Gardens, Fonthill, Tisbury, Wilts.
ARCHER, James, Assistant Forester, Culzean Castle, Maybole.
ARCHER, John, Assistant Forester, Culzean Castle, Maybole.
*ARCHIBALD, Thomas, Forester, Virginia, Co. Cavan, Ireland.
ARNOTT, Alexander, Hedger, East Wemyss, Fife.
ASHDOWN, Samuel Harding, Land Agent, Uppington, Wellington, Salop.
AUSTIN & M'AUSLAN, Messrs, Nursery and Seedsmen, Glasgow.

BAIGRIE, Andrew, Forester, Mote Park, Ballymurry, Co. Roscommon.
BAIGRIE, William, Forester, Echo Bank, Old Dalkeith Road, Edinburgh.
BAILLIE, William, Wood Manager, Cortachy, Kirriemuir.
BAIRD, Joseph, Assistant Forester, Drumpellier, Coatbridge.
BALDEN, James, Forester, Lennoxlove, Haddington.
BALDEN, Joseph, Overseer, Houghton Estate, Preston.
*BALDEN, Peter G., Forester, Vaenol Park, Bangor, North Wales.
*BALDEN, William, Appleby Castle, Appleby.
*BALLANTYNE & SON, Messrs John, Nurserymen and Seedsmen, Dalkeith.
BALLINGAL, Robert, Factor, Ellabus, Islay.
*BARRIE, David, Forester, Durris, Aberdeen.
*BARRIE, James, Forester, Stevenstone House, Torrington, Devonshire.
BARTER, Frederick, Assistant Gardener.
BATY, David, Forester, Lowther Castle, Penrith.
BATY, William, Forester, Netherby, Longtown.
BAXTER, Robert, Forester, Dalkeith Park, Dalkeith.
*BAYNE, Lewis, Forester, Kinmel Park, Abergele, North Wales.
BEGBIE, Harker, Forester, 19 Tarvit Street, Edinburgh.
BEGG, John, jun., Factor, Durris, Aberdeenshire.
BELL, James, Strathfieldsaye, Winchfield, Hants
BELL, James, Forester, Newcastleton, Carlisle.
BENNETT, Alexander, Forester.

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Berry, George, Longleat, Horningsham, Warminster, Wiltshire.
Berry, Thomas Walter, Forester, Brynkinalt, Chirk, N. Wales.
Bigge, Matthew, of Islip, Thrupston.
Birch, John, Assistant Gardener, Tinnchinch, Enniskerry, Co. Wicklow.
*Birnie, John, Normanby Park, Brigg, Lincolnshire.
Bissett, David, Land-Steward and Forester, Alva House, Stirling.
Bissett, William S., Land-Steward and Forester, Moncrieffe House, Bridge of Earn, Perthshire.
Blair, Peter, Dunse.
*Boa, Andrew, Lang-Steward, Dalton House, Newcastle-on-Tyne.
Boa, Andrew, jun., Assistant Factor, Blackwood, Lesmahagow.
Boa, James S. M., Agent, Fettercairn, Fettercairn.
*Borthwick, William, Forester, Dunnichen, Forfar.
Boston, Thomas C.
Bottomer, Frederick, The Gardens, Mackree Castle, Ballisodare, Sligo.
*Brodie, James, Land-Steward, Glasslough, Armagh, Ireland.
Brough, James, Assistant Forester, Cluny Castle, Aberdeen.
Brough, Robert, Forester, Balnagowan, Tain, Ross-shire.
Brown, J., Bretby, Burton-on-Trent.
Brown, James, LL.D., Nurseryman and Wood-Surveyor, Craigmill, Stirling.
Brown, James, Carnwath House, Carnwath.
Brown, John E., Craigmill, Stirling.
*Brown, R. E., F.G.S., Agent, Famley Hall, Otley, Yorkshire.
Brown, William, Land Valuator and Estate Agent (N. America).
Brown, William, Nursery and Seedsman, Stamford, Lincolnshire.
*Bruce, Peter.
Bruce, T. R., of Slogarie, Lauriestown, Castle-Douglas.
Bryan, F. G. D., Factor, Drumpellier, Coatbridge.
Brydon, John, Assistant Forester, Ardgowan, Greenock.
Buchan, Alexander, F.R.S.E., Secretary of the Scottish Meteorological Society, Edinburgh.
Buchan, George, Forester, Bakewell, Derbyshire.
Buchanan, Robert R., Forester, Dunse Castle, Dunse.
Burnett, James, Assistant Forester, Durris, Aberdeenshire.

Calder, Frederick, Forester, Brucklay Castle, Aberdeenshire.
Calloghin, John, Assistant Forester, Houston, Paisley.
Cameron, Alexander, Forester, Countlich Lodge, Ballinluig, Perthshire.
Cameron, Angus, Assistant Forester, Altyre, Forres.
Cameron, Henry, Assistant Forester, Linkwood, Elgin.
Cameron, Hugh, Assistant Forester, Novar, Evanton, Ross-shire.
*Cameron, John, Assistant Forester, Fowlis Wester, Crieff, Perthshire.
Cameron, Robert, Forester, Galtie Castle, Mitchelstown, Tipperary.
Campbell, Alexander, Forester, Gray House, Liff, Dundee.

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*Campbell, James, of Tillichewan Castle, Dumbartonshire.
Campbell, John, Forester, Aboyne Castle, Aberdeenshire.
Campbell, Peter, Assistant Forester, Invereshie, Kingussie.
Cairnduff, Andrew, Forester, Abbeyleix, Queen's Co., Ireland.
Carmichael, John, The Gardens, Glen Tulchan, The Cairnies, Perth.
Chalmers, James, Duchal, Port-Glasgow.
Chambers, William, of Haford, Aberystwith, Wales.
Chaplain, George, Assistant Forester, Glamis Castle, Glamis, Forfarshire.
Chapman, James, Assistant Forester, Grinkle Park, Saltburn-by-the-Sea, Yorkshire.
Chapplow, John, Glencoin Cottage, Patterdale, Penrith.
Christie, A. D., Foreman, Heaton Park Gardens, Manchester.
Christie, David, Forester, Abington House, Lanarkshire.
*Churnside, Francis, Forester, Ladykirk, Berwickshire.
Churnside, Robert, Forester, Edlingham, Alnwick.
Clark, David, Assistant Forester, Ury House, Stonehaven.
Clark, James, Forester, Balvaird Cottage, Strathmiglo, Fife.
Clark, John, The Nurseries, Cupar, Fife.
*Clark, John, jun., Forester, Esslemont, Ellon, Aberdeenshire.
*Clark, J., Forester to the Earl of Kintore, Keith Hall, Aberdeenshire.
Clark, Thomas, Beechwood Gardens, Bortly, Hants.
Clark, William, Assistant Forester, Hawkhead, Paisley.
*Cleghorn, William, Forester, Ayton Castle, Ayton.
Clerk, Sir George D., Bart, Penicuik House, Penicuik.
Cobban, John, Wood Agent, Wentworth Woods, Rotherham.
Cockburn, William, Forester, Coats, Penicuik.
Cocker, James, Nurseryman, Aberdeen.
Collingwood, Rev. R. G., Irton Vicarage, Carnforth, Cumberland.
Cookes, Rev. H. W., Astley Rectory, near Stourport.
Cooper, George, Messrs Hurst & Son, Leadenhall Street, London.
Corbet, James, Forester, Underley Hall, Kirkby Lonsdale, Westmoreland.
*Cowan, James, Forester, Bridgend, Islay.
Cowan, Robert, Forester, Park, near Paisley.
Cowe, John, Luffness, Drem.
Cowie, John, Assistant Forester, Mount Stuart, Rothesay.
*Crabbe, James, Forester, Glamis Castle, Glamis, Forfarshire.
*Craig, James, Overseer, 192 Bonnington Road, Edinburgh.
Craig, Nathan, Cherry Cottage, Anowe Park, Birkenhead.
Craig, Richard, Forester and Gardener, Carlowrie, Kirkliston.
Craig, Robert, Levens Hall, Milnthorpe.
Cranston, G. C. Trotter, of Harvieston, Gorebridge.
Cranston, James, Assistant Forester, Floors Castle, Kelso.
*Crichton, George, 18 Princes Street, Edinburgh.
Crosbie, John, Forester and Ground Officer, Ballindalloch Castle, Ballindalloch, Banffshire.

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*Cross, David G., Forester, Kylisk, Nenagh, Ireland.
Cruickshanks, Robert, Forester, Ballykilcavan, Stradbally, Queen's Co.
Cumming, Donald, Assistant Forester, Newbattle, Dalkeith.
Cunningham, D., The Gardens, Darnaway Castle, Forres.
Cunningham, John, Forester, Ardross Castle, Ross-shire.
Currie, John, Gardener, Salisbury Green, Edinburgh.
*Cutler, D., Forester, Darnaway Castle, Forres.

Dalgleish, John J., W.S., 8 Athole Crescent, Edinburgh.
Dallas, Joseph, Forester, Blandpant, Llandyssil, Carmarthenshire.
Dalrymple, Charles, Forester, Mitchelstown Castle, Mallow, Co. Cork.
Daniels, Peter, Forester, Slindon Hall, Arundel, Sussex.
Darien, James, Assistant Forester, Hopetoun House, South Queensferry.
*Darling, John, Forester, St Martins, Perthshire.
Davidson, James, Coonoor, Neilgherries, S. India.
*Davidson, John, Forester, Aldbar, Brechin.
Davidson, John, Forester, Firth, Roslin.
*Davidson, John, Overseer and Architect, Belmont Castle, Meigle.
Davidson, Richard, Scottish Colour Works, Leith.
Davidson, W., Leager House, Chuseburn Grange, Newcastle-on-Tyne.
*Dawson, John, Messrs J. & J. Dawson, Alloa.
Dean, Richard, Ealing, London.
Dempsey, Charles, Assistant Forester, Powerscourt, Enniskerry.
Dick, Joseph, Assistant Forester, Scone, Perth.
*Dickson, George, Stronvar, Lochearnhead.
Dickson, J., Messrs Edmonston Brothers, 9 Dame Street, Dublin.
Dickson & Sons, Messrs James, Nursery and Seedsmen, Chester.
*Dickson & Sons, Messrs James, Nursery and Seedsmen, Edinburgh.
Dickson, Thomas, Nursery and Seedsman, Chester.
Dodds, George, Overseer, Leinster Estates, Prospect House, Athy.
Don, John, Assistant Forester, Ardgowan, Greenock.
Donald, Alexander, Forester, Woodhall House, Airdrie.
Donaldson, J., Forester, Brechin Castle, Brechin.
Douglas, J., Gardener, Kilkea Castle, Mageney, Co. Kildare.
*Dow, Thomas, Forester, Idvies, Forfar.
*Downie, Laird, & Laing, Messrs, Nursery and Seedsmen, Edinburgh.
Doyle, James, Land Steward, Heywood, Ballinakill, Queen's County.
Drummond Brothers, Messrs, Nursery and Seedsmen, Edinburgh.
Drummond & Sons, Messrs William, Nurserymen, Stirling.
Duff, James, Factor, Blackwood, Lesmahagow.
*Duff, James, Melgund, Aberlemno, Forfar.
Duff, James, Wood Manager, Bayham Abbey, Tunbridge Wells.
Dugan, Charles, Assistant Forester, Cally House, Gatehouse.
Duncan, Charles, of Woodend, Rothesay.
Duncan, John, Forester, Blandpant, Llandyssil.

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DUNLOP, Alexander, Factor, Luffness, Drem.
DUNN, David, The Gardens, Heaton Park, Manchester.
*DUNN, Malcolm, The Gardens, Dalkeith Park, Dalkeith.
DURWARD, Robert, Manager, Bielack, Aberdeenshire.
DYKES, Thomas, Factor, Maybole, Ayrshire.

EARNSHAW, L., Forester, Morpeth, Northumberland.
EDEN, The Hon. R. Henley, Estate Agent, The Coigne, Minchinhampton.
EDGAR, Thomas, Forester, Torry, Fife.
EDMONDSON, T., Proprietor of "Gardeners' Record," 9 Dame Street, Dublin.
ELIBANK, Right Hon. Lord, Darnhall, Eddlestone, Peebles.
ELLIOT, Robert, Forester, Blairquhan, Maybole, Ayrshire.
EWING, David, Assistant Forester, Urie House, Stonehaven.

FAIRBAIRN, William, Land Steward, Manderston, Dunse.
FERGUSON, A., Gosfield Hall, Hallstead, Essex.
FERGUSON, James, Forester and Land Steward, Cleghorn, Lanark.
FERGUSON, Joseph, Assistant Forester, Lambton Park, Fence Houses.
FERNIE, Robert, Forester, Balcarres, Colinsburgh, Fife.
FETTES, Francis, Assistant Hedger, Ury House, Stonehaven.
FINGLAND, J., Forester, Drumlanrig, Thornhill, Dumfriesshire.
FINN, P. W., Forester, Borris House, Borris, Co. Carlow.
FISHER, William, Forester, Wentworth Castle, Barnsley, Yorkshire.
*FORBES, Andrew, Forester, Stracathro, Brechin.
FORBES, Willam, Assistant Forester, Castlecary, Denny.
FORGAN, James, Wellwood Cottage, Kinnoull, Perth.
FORREST, William, Melfort Cottage, Lochgilphead.
FOULIS, Robert, M.D., Cairnie Lodge, Cupar, Fife.
FOULIS, Robert, Forester, Fordel, Inverkeithing, Fife.
FOWLER, Archibald, The Gardens, Castle Kennedy, Stranraer.
FRANCE, Charles, Forester, Culzean Castle, Maybole, Ayrshire.
*FRANCE, C. S., Overseer, Penicuik House, Penicuik.
*FRANCE, George, Overseer, Glenelg, Lochalsh.
FRANCE, James, Assistant Forester, Culzean Castle, Maybole, Ayrshire.
FRASER, Archibald, Assistant Forester.
*FRASER, Duncan, Forester.
FRASER, James, Assistant Forester, Drumpellier, Coatbridge.
FRASER, P. Neill, Canonmills Lodge, Edinburgh.
FRASER, Hugh, Stanwell Nursery, Edinburgh.
FRASER, Simon, Forester, Haddo House, Aberdeenshire.
*FRASER, Thomas, Forester, Oriel Temple, County Louth.
FREEMAN, Timothy, Messrs Osborne & Sons, Fulham, London.
FROST, Philip, Gardener, Dropmore, Maidenhead.

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*Gardiner, R., Wenalt House, Crosswood, Aberystwith, South Wales.
Gardiner, James, Forester, Hawkstone Park, Salop.
Gargan, James, Land Steward, Kells, Moynally, Co. Meath, Ireland.
Garner, John, Assistant Gardener, Cantley Hall, Doncaster, Yorkshire.
Geikie, P. M., Factor, Cortachy, Kirriemuir.
Gerrish, Edward, Wood Overseer, Maiden Bradley, Bath.
Gibson, William, Nursery and Seedsman, 14 Lower Ormond Quay, Dublin.
Gibson-Maitland, Sir A. C. R., Bart., M.P., Cliftonhall, Ratho.
Gilbert, James, Forester, Ardverikie, Kingussie.
*Gilchrist, Andrew, Forester, Ury House, Stonehaven.
Gilchrist, Daniel, Messrs Main & Co., 15 George IV. Bridge, Edinburgh.
*Gilchrist, William, Forester, Cluny Castle, Aberdeen.
Glendinning, George P., Dalmeny Park, South Queensferry.
Goodfellow, Andrew, Forester, Wolfelee, Hawick.
Goodier, George, Assistant Gardener.
Gordon, James, Assistant Forester, Botanic Garden, Edinburgh.
Gordon, John, Forester, 17 Bon-Accord Street, Aberdeen.
Gorrie, Archibald, Forester, Holkham Hall, Holkham.
*Gorrie, William, Rait Lodge, Trinity, Edinburgh.
*Gossip, James, The Nurseries, Inverness.
Gow, James, Forester, Camperdown, Dundee.
Gow, John L., Factor, Raith, Kirkcaldy.
Graham, Andrew, Alma Cottage, St Boswells.
Grandison, James, Assistant Forester, New Scone, Perth.
Grant, Colonel James A., C.B., C.S.I., 7 Park Square, Regent's Park, London.
Grant, Donald, Forester, Drumin, Ballindalloch.
Grant, James, Assistant Forester, Abernethy, Strathspey.
Grant, John, Assistant Forester, Abernethy, Strathspey.
Green, Alexander, Assistant Forester, Culzean Castle, Maybole.
Green, William, Assistant Forester, Charleston, Malmesbury, Wilts.
Greer, Robert, Assistant Forester, Ardgowan, Greenock.
*Greig, Gavin, Forester, Parkhill, Aberdeen.
Grieve, George, Gardener, Dalkeith.
Grieve, James, Messrs Dickson and Co., Nurseries, Leith Walk, Edinburgh.
*Grigor, John, Nurseryman, Forres.
Guthrie, Colonel, Carlogie House, Carnoustie.

*Hall, Peter, Forester, Huntly Lodge, Huntly.
Hamilton, David, Forester, Tillichewan Castle, Alexandria, Dumbarton.
Hamilton, John B. Baillie, of Arnprior, Cambusmore, Callander.
Handasyde & Davidson, Messrs Thomas, Nurserymen, Musselburgh.
Hardie, A., Manager, Monboddo, Fordoun.
*Hardie, Walter, Forester, The Hall, Norwell, Newark, Notts.
*Harley, Andrew, Penybout, Radnorshire.

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HARBOLD, George, Gardener, Mount Henrie, Queen's Co., Ireland.
HARROWER, William, Forester, Glen App, Ballantrae, Ayrshire.
HART, Thomas, Assistant Forester, Yester, Haddington.
HARTLAND, Richard, The Lough Nurseries, Cork.
HAVELOCK, Thomas, Forester, Raby Park, Staindrop, Co. Durham.
HAYMAN, John, jun., Overseer, Dumfries House, Old Cumnock.
HEALE, William, Dean Park Nurseries, Edinburgh.
HELMAN, George, Assistant Gardener.
HELMAN, William, Gardener, Heywood, Ballinakill, Queen's County.
*HENDERSON, Archibald, Forester, Clonad Cottage, Tullamore, King's County.
HENDERSON, John, Land Steward, Knockdrin Castle, Mullingar.
HENDERSON, Robert, Assistant Forester, Dalmeny Park, Edinburgh.
HENDRY, David, Bangholm Nurseries, Edinburgh.
HEPBURN, James, Forester.
*HEPBURN, William, Assistant Forester, Altyre, Forres.
HERMISTON, James, Assistant Forester, Floors Castle, Kelso.
HETHERTON, Walter, Forester, Heanton, Satchville, Bedworth, N. Devon.
HILL, John, Land Steward, Whitehill, Lasswade.
HILSON, John, Assistant Forester, Floors Castle, Kelso.
*HOGARTH, James, Forester, Duthill, Strathspey.
HOGG, Thomas, Forester, Hampton Court, Leominster, Hereford.
HOOD, James, Assistant Forester, Langlee, Jedburgh.
HOOD, William, Gardener, Glasslough, Ireland.
HOME, George, Assistant Forester, Drumlanrig, Thornhill.
HORSBURGH, James, Forester, Yester, Haddington.
HUME, Andrew, Forester, Wansford, Peterborough.
*HUNTER, Patrick, Overseer, Glenarm Castle, Larne, Ireland.
HUNTER, William, Forester, Castlemilk, Glasgow.
HUSSEY, Samuel, M., Estate Office, Tralee.
*HUTTON, James, Forester, Moy, Forres.

JAMIESON, D., Thoresby Park, Ollerton, Nottinghamshire.
JEFFREY, John, of Balsusney, Kirkcaldy, Fife.
JEFFREY, John, Forester, Craighall, Blairgowrie.
JOHNSTON, James.
JOHNSTON, William, Fencer, Lee, Lanark.
JOHNSTONE, Alexander, Assistant Forester, Arniston, Gorebridge.
JOHNSTONE, Alexander, Assistant Forester, Penicuik House, Penicuik.
*JOHNSTONE, William, Bangholm House, Ferry Road, Edinburgh.
JOSS, John, Assistant Forester, Crathes Castle, Aberdeenshire.

*KAY, James, Forester and Hedger, Bute Estate, Rothesay.
*KEDZIE, Walter, Forester, Arundel Castle, Arundel, Sussex.
KEIR, David, Forester, Blair Athole, Perthshire.
*KEMP, John, Assistant Forester, Midmar, Aberdeenshire.

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KENNEDY, Duncan, Assistant Forester, Erskine House, Glasgow.
KENNEDY, F., Seed Merchant, Borough, London.
KENNEDY, G. G. Allan, Assistant Forester, Gothic House, Morden, Surrey.
KENNEDY, JOHN, Forester and Ground Officer, Glen Urquhart, Drumnadrochit.
KENNEDY, William, Overseer, Carradale, Greenock.
KIDD, James, Assistant Forester, Morden Park, Surrey, S.W.
*KINGHORN, Adam, Forester, Rochsoles, Airdrie.

LAING, James, Assistant Forester, Penicuik House, Penicuik.
LAMBERTON, Hugh, Forester, Orwell Park, Bucklesham, Ipswich.
LAMONT, John, Inverleith Nurseries, Edinburgh.
*LAUDER, William, Messrs Carr & Co., Timber Yard, Walker-on-Tyne.
LAURISTON, Alexander, Assistant Forester, Meldrum House, Old Meldrum.
LAWSON & SON, Messrs Peter, Edinburgh.
LEGGAT, Alexander, Assistant Forester, Abernethy Nursery, Strathspey.
LEISHMAN, Richard, Forester, Muncaster Castle, Ravenglass, Cumberland.
LEMON, Thomas, The Gardens, Convamore, Ballyhooly, Ireland.
LENOX, William, Forester, Keir, Dunblane.
LIDDELL, Rev. J. R., The Manse, Kirkliston.
LINDORES, Gavin, Assistant Forester.
LINKSTONE, James, Assistant Forester, Dalmeny Park, Edinburgh.
LITTLE, Alexander, Forester, Castle Menzies, Aberfeldy.
LORAINE, Edward, The Riding Mill, Northumberland.
LOTHIAN, The Most Hon. The Marquis of, Pinnelheugh House, Jedburgh.

M'AINSH, Robert, Assistant Forester, Drumore, Stirling.
M'ALISTER, Alexander, Rossie Priory, Dundee.
MACBETH, J., Land Steward, Stobhall, Perth.
M'CALLUM, James Thyne, Nursery and Seedsman, 60 Buchanan Street, Glasgow.
M'CALLUM, G. K., of Braco Castle, Braco.
M'COLL, James, Forester, Clifton Park, Kelso.
*M'CORQUODALE, Donald, Forester, Dunrobin Castle, Golspie.
M'CORQUODALE, D. A., Assistant Factor, Panmure, Forfarshire.
*M'CORQUODALE, William, Forester, Scone Palace, Perth.
M'CREATH, Hugh, Assistant Forester, Culzean, Maybole, Ayrshire.
M'CUTCHEON, Robert, Assistant Forester, Cawdor Castle, Nairn.
M'DONALD, Alexander, Forester, Drumpellier, Coatbridge.
M'DONALD, Charles, Superintendent, Phœnix Park, Dublin.
M'DONALD, Donald, Assistant Forester.
*M'DONALD, John, Forester, New Scone, Perth.
M'FADYEN, Duncan, Forester, Dunmore, Stirling.
M'GRATH, Patrick, Assistant Forester, Galtie Castle, Mitchelstown, Co. Tipperary.

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M'Gregor, Archibald, Assistant Forester, Hopetoun House, South Queensferry.
M'Gregor, W. S., Forester, Dupplin Castle, Perth.
M'Hardy, Charles, Forester, Castle Newe, Strathdon.
M'Hattie, John, Seedsman, Northgate, Chester.
M'Intosh, Angus, Forester, Glashill, Killeigh, King's County.
Mackay, John, West Dean Estate, Chichester.
M'Kay, James, Forester, Whittinghame, Prestonkirk.
M'Kay, Thomas, Forester.
M'Keith, Archibald, West Coates Nursery, Edinburgh.
M'Kenzie, Donald F., Forester, Meldrum House, Aberdeenshire.
Mackenzie, Alexander, Warriston Nurseries, Edinburgh.
Mackenzie, James, 1 George IV. Bridge, Edinburgh.
Mackenzie, John Ord, W.S., of Dolphinton, 7 Royal Circus, Edinburgh.
M'Kenzie, K. Stewart, of Brahan Castle, Dingwall.
Mackie, John, Assistant Forester, Ballogie, Aboyne.
Mackintosh, R. T., Nursery and Seedsman, Edinburgh.
M'Lagan, John, Forester, The Cairnies, Methven, Perthshire.
*M'Laren, Hugh.
M'Laren, John, Ballencrieff, Drem.
*M'Laren, John, Forester, Hopetoun House, South Queensferry.
M'Laren, John, Forester, Darnhall, Eddleston, Peebles.
M'Laren, Peter, Forester, Altyre, Forres.
*M'Laren, Peter, Sub-Agent, Sittenham, York.
M'Lean, Andrew, Assistant Forester, Rutherford, Kelso.
M'Lean, John, Forester, Swainston, near Newport, Isle of Wight.
M'Lean, Malcolm, The Gardens, Gosford, Drem.
M'Lean, William, Forester, Eglinton, Castle, Irvine.
M'Leay, William, Messrs Methven & Sons, Nurserymen, Edinburgh.
M'Lellan, Duncan, Superintendent of Parks, Glasgow.
M'Leod, Alexander, Forester, Gosford, Drem.
M'Millan, Samuel, Assistant Forester, Dunse Castle, Dunse.
Macnaughton, Alexander, S.S.C., Arranmore Villa, Stanley Road Edinburgh.
M'Naughton, Archibald, Forester, Williamwood, Cathcart, Glasgow.
M'Neill, James, Forester, Abercairney, Crieff.
M'Neill, James, Forester, Houghton Hall, Rougham, Norfolk.
M'Neill, D., Timber Agent, Kirriemuir.
M'Rae, John, Forester, Auchendennan House, Alexandria, Dumbartonshire.
M'Rae, Robert, Assistant Forester, Cullen House, Cullen.
M'Ritchie, T. E., W.S., 4 Gayfield Square, Edinburgh.
Main, John, Forester, Bryan Hall, Ferrybridge, Yorkshire.
Main & Co., Messrs A. & J., Wire Fence Manufacturers, 7 Renfield Street, Glasgow.

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Maitland, William, Assistant Forester, Keith Hall, Aberdeenshire.
Marr, John, Assistant Forester, Darnaway Castle, Forres.
*Marshall, J., Forester, Lambton Park, Fence Houses, Durham.
Marshall, James, Forester, Preston, Dunse.
Marshall, Robert, Forester, Horton Manor, near Epsom.
Marshall, Robert, Assistant Forester, Ardgowan, Greenock.
Martin George, Forester, Dunecht House, Aberdeen.
Martin & Sons, Messrs, Nurserymen, Cottingham, Hull.
Mathieson, Donald, Meikleour, Perth.
Maxton, Robert, Forester, Strathallan Castle, Auchterarder.
Melrose, John, Wood Merchant.
Melrose, William, Forester, Byram Hall, South Mitford.
Menzies, George, Agent, Trentham, Stoke-on-Trent.
Menzies, William, Forester, Craigton Cottage, Causewayhead, by Stirling.
Methven, John, Nursery and Seedsman, Edinburgh.
*Michie, Christopher Young, Forester, Cullen House, Cullen, Banffshire.
*Michie, James, Forester, Wemyss Castle, Kirkcaldy.
Middlemass, Archibald, Forester, Dunans House, Colintraive, Greenock.
Milne, James, Forester, Glenmuick, by Ballater.
*Miller, John, Forester, Ochtertyre, Stirling.
*Mitchell, David, Nurseryman, Edinburgh.
Mitchell, Forbes, of Thainstone, Kintore.
Mitchell, Garlies, Nurseryman, Stranraer.
Mitchell, James, Aldie, Kinross.
Mitchell, James, Forester, Knossington Grange, Oakham, Leicestershire.
Moffat, Adam, Forester, Hindlip Hall, Worcester.
Moffat, Henry, Forester, Monkray, Whitehaven, Cumberland.
Moffat, James, Forester, Newbattle Abbey, Dalkeith.
Moffat, John, Forester, Kimmerghame, Dunse.
Morrison, John, Coney Park Nursery, Stirling.
Morrison, R., Nurseryman, Elgin.
Muir, William, of Inistrynich, Inverary, Argyllshire.
*Muirhead, John, Forester, Bicton, Budleigh Salterton, Devonshire.
Mullens, J., Gardener.
Munro, James, Forester, Invermorriston, Inverness-shire.
Munro, James, Assistant Forester, Darnaway Castle, Forres.
Munro, John, Assistant Forester, Cluny Castle, Aberdeen.
Murray, David, Forester, Dunira, Perthshire.
Murray, Robert, Nurseryman, Lanark.
Myles, James, Forester, Portmore, Eddlestone, Peebles.

Neil, Archibald, Forester, West Grange, Culross.
Newbigging, Alexander T., Nurseryman, Dumfries.
Nicol, W., Assistant Forester, Eglinton Castle, Irvine.

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NICOL, William, Forester, Pitcaple, Aberdeenshire.
NOTMAN, David, Nursery Foreman, Dean Park Nurseries, Edinburgh.

*OGILVY, David, Assistant Forester, Cortachy, Forfar.
O'NEILL, Richard, Auctioneer, Old Castle, Co. Meath.
*ORMISTON & RENWICK, Messrs, Nursery and Seedsmen, Melrose.

*PALMER & SON, Messrs John, Nurserymen, Annan.
*PARKER, James, Forester, Belvoir Castle, Grantham.
PARKER, Robert A., Nursery and Seedsman, Lanark.
*PATERSON, Andrew, Surveyor, Exton, Oakham, Rutland.
PATERSON, Charles, Factor, Castle Menzies, Aberfeldy, Perthshire.
PEEBLES, Andrew, Highclere Castle, Newbury, Berks.
PENDER, John, M.P., of Minard Castle, Argyllshire.
PENDREIGH, John, Assistant Forester, Port Bannatyne, Rothesay.
PHILIP, John, Wood Merchant, Bonnyrigg, Lasswade.
*PHILIP, Robert, Minsterley, Shrewsbury.
PIERSON, Joshua, Forester, Old Shields, Airdrie.
PIRIE, John, Forester, Blackhall, Aberdeenshire.
POWERSCOURT, The Lord Viscount, Powerscourt, Enniskerry, County Wicklow.
POWNER, George, Forester, Willey Hall, Broseley, Shropshire.
POWNER, Thomas, British Workman's Rooms, Wellington.
PRESSLEY, D., Gardener, Knockmaroon, Chapelizod, Dublin.
PRICE, J., Forester, Garnstone Castle, Hereford.

RAIT, James, Forester, Castle Forbes, Whitehouse, Aberdeen.
RAMSDEN, Sir J., Bart., M.P., Buckden, Skipton, York.
RANKINE, Thomas, Nurseryman, Hamilton.
RATTRAY, Thomas, Forester, Westonbilt House, Tetbury, Gloucestershire.
*RAVENSCROFT, Edward, "Farmer" Office, India Buildings, Edinburgh.
REA, Archibald Henry, Assistant Forester, Ury House, Stonehaven.
*REID, George, Nursery and Seedsman, Aberdeen.
REID, James, Assistant Forester, Dalkeith Park, Dalkeith.
RICHARDSON, Adam, Assistant Forester, Arniston, Gorebridge.
*RICHARDSON, Alexander, Land Steward, Arniston, Gorebridge.
RIGHY, William, Messrs King & Co., 45 Pall Mall, London.
RINTOUL, Henry, Leith Walk Nurseries, Edinburgh.
RITCHIE, Henry, Eridge Castle, Tunbridge Wells.
*RITCHIE, Walter, Forester, Dinnas Mawddwy, Shrewsbury, N. Wales.
ROBERTSON, D., Albert Hotel, Hanover Street, Edinburgh.
ROBERTSON, David, Estate Manager, Curraghmore, Portlaw, Waterford.
ROBERTSON, George, Forester, Benmore, Kilmun, Greenock.
ROBERTSON, James.

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ROBERTSON, James, Forester, Drummond Castle, Crieff.
ROBERTSON, John.
ROBERTSON, John, Forester, Minto House, Hawick.
ROBERTSON, John, Assistant Forester.
ROBERTSON ——, Forester, Markree Castle, Collooney, Co. Sligo.
ROBERTSON, P. S., Nursery and Seedsman, Edinburgh.
ROBERTSON, Thomas, Forester.
ROBERTSON, William W., Forester, Carolside, Earlston.
*ROBSON, Alexander, 10 Hospital Street, Dundee.
ROBSON, David, Assistant Forester, Arthur Stone, by Meigle.
ROBSON, John, Forester.
ROBSON, Ralph, Nursery and Seedsman, Hexham.
RODGER, Hugh, Factor, Cleland, Motherwell.
*RUSSELL, John, Craigie, Ayr.
RUSSELL, Robert, Forester, Mostyn, Holywell, N. Wales.
RUST, Joseph, The Gardens, Eridge Castle, Tunbridge Wells, Kent.
*RUTHERFORD, Andrew, Forester, Bowmont Forest, Kelso.
*RUTHERFORD, James, Forester, Linthaugh, Jedburgh.
*RUTHERFORD, James, Agent, Kirkleatham, Redcar, Yorkshire.
RUTHERFORD, John, Assistant Forester, Linthaugh, Jedburgh.
RUTHERFORD, Robert, Manager, Invereshie, Kingussie.
RUTHERFORD, Thomas, Hothfield, Ashford, Kent.

*SADLER, John, F.R.Ph.S., Experimental Cottage, Edinburgh.—*Secretary.*
*SAMSON, John, Forester, Abernethy, Strathspey.
*SANDBACH, Henry R., Hafodunos, Llanrwst, Denbighshire.
SCARTH, T. W., Land Agent, Keverstone, Staindrop, Darlington.
SCOTT, Adam, Forester, Southwick Park, Fareham, Hants.
SCOTT, Andrew, Assistant Forester, Newton Don, Kelso.
*SCOTT, D., Wood-Manager, Darnaway Castle, Forres.
*SCOTT, David, Forester, Broadford, Limerick.
SCOTT, John, Forester.
*SCOTT, John W., Delgany, County Wicklow, Ireland.
SCOTT, Walter, Forester, Oxnam, Jedburgh.
SCRIMGEOR, James, Under Forester, Altyre, Forres.
SEATON, Allan, Assistant Forester, Curraghmore, Portlaw, Co. Waterford.
SERVICE, George, Assistant Forester, Dunse Castle, Dunse.
SERVICE, James, Assistant Forester, Dunse Castle, Dunse.
SHAND, James, Gardener, Meldrum House, Aberdeenshire.
SHANKS, John, Forester, Kildrummy Castle, by Mossat.
SHEPPARD, John, Tweedside Cottage, Roehampton, Surrey.
SIM, William, Nurseryman, Forres.
*SIMPSON, J., Forester, Alloa Park, Alloa.
SIMPSON, Peter, Assistant Forester, Daughty Mill, Kirkcaldy.
*SIMPSON, Thomas, Forester, Glenferness, Nairnshire.

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SINTON, David, Assistant Forester, Charlton, Malmesbury, Wilts.
SINTON, J., Forester, Stourhead, Bath.
SINTON, John, Forester, Charlton, Malmesbury, Wilts.
SKELDON, John, Assistant Forester, Dunse Castle, Dunse.
SKIRVING, Archibald, Forester, Duncombe Park, Helmesley, York.
SKIRVING, John Finlay, Assistant Forester, Duncombe Park, Helmesley.
SKIRVING, William, Nursery and Seedsman, Liverpool.
*SLATER, Andrew, Forester, Lofthouse, Saltburn-by-the-Sea, Yorkshire.
SLATER, Andrew, jun., Assistant Forester, Aske, Richmond, Yorkshire.
*SMART, A. H.
SMITH, A., Factor, Douglas Castle, Lanarkshire.
SMITH, G. B., Wire Fence Manufacturer, 56 West Regent St., Glasgow.
*SMITH, James, Forester, Donibristle, Aberdour, Fife.
SMITH, James, The Gardens, Exton Park, Oakham, Leicestershire.
SMITH, John, Forester, Windmill Cottages, Ladybank, Fife.
SMITH, John Crombie, Assistant Forester, Drummond Castle, Crieff.
SMITH, Thomas, Nurseryman, Stranraer.
SMITH, W. Baxter, Messrs Little & Ballantyne, Nursery and Seedmen, Carlisle.
SMITH & SIMMONS, Messrs, Nursery and Seedsmen, Howard St., Glasgow.
*SMITH & SON, Messrs William, Nursery and Seedsmen, Aberdeen.
SOLLY, Professor Edward, F.R.S., Parkstone, near Poole.
SOMERVILLE, Samuel, M.D., F.R.C.P., 17 Hart Street, Edinburgh.
SPENCE, Charles, Assistant Forester, Drumpellier, Coatbridge.
STALKER, Donald, Assistant Forester.
STAPYLTON, Major, Myton Hall, Borobridge, Yorkshire.
STEELE, David, Forester, Skene House, Aberdeen.
STEPHEN, James, Forester, Dochfour, Inverness.
STEPHEN, John, jun., Assistant Forester, Cluny Castle, Aberdeen.
STEVENSON, David, Forester, Kelly, Wemyss Bay, Greenock.
*STEVENSON, James, Forester, Cobham Park, Surrey.
STEWART, Alexander, Chancelot House, Ferry Road, Edinburgh.
STEWART, Alexander, Forester, Gringle Park, Saltburn-by-the-Sea, Yorkshire.
STEWART, D., Manager, Dalnavert, Aviemore.
STEWART, James, Assistant Forester, Drumpellier, Coatbridge.
STEWART, John, Forester, Blair Athole, Perthshire.
STEWART, John, Forester, Castlecary, Denny.
STEWART, Peter, Gardener and Forester, Castle Wellan, Co. Down.
STEWART, William, Land Steward, Dalhousie Castle, Lasswade.
STEWART, William, Nurseryman, Dundee.
STEWART, William, Assistant Forester, Underley Hall, Kirkby.
STEWART, William, Assistant Forester, Logie Almond, Perth.
STRANG, William, Assistant Forester, New Scone, Perth.
STUART, John, Forester, Castle Grant, Strathspey.

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*Stuart, Lewis A. G., Forester, Netherdale House, Turriff.
Stuart, William, Forester.
Stuart & Mein, Messrs, Nurserymen, Kelso.
Suttie, James, Evington, Ashford, Kent.
Swan, R. G., Auctioneer, Dunse.
Swinton, A. Campbell, LL.D., F.R.S.E., of Kimmerghame, Dunse.
Syme, David, 1 George IV. Bridge, Edinburgh.
Symon, John, Forester, Cawdor Castle Nairn.
Symon, Peter, Forester, Forres.

Tait, David, Forester, Owston Park, Doncaster, Yorkshire.
Tait, Walter, Seedsman, 45 Chapel Street, Dublin.
Taylor, David, Barskimming, Mauchline.
Taylor, George, Forester, Monymusk, Aberdeenshire.
Taylor, George, Nursery and Seedsman, Inverurie.
Thomson, James Scott, Strathallan Castle, Auchterarder.
Thomson, Lockhart, S.S.C., 22 Coates Crescent, Edinburgh.
Thomson, Thomas, Forester, Penicuik House, Penicuik.
Thornton, Thomas, Heatherside, Frimley, Surrey.
Tivendale, William, Forester, Houston, near Paisley.
Tomlinson, J., Brocklesby Park, Ulceby.
Tomlinson, Wilson, Assistant Forester, Belvoir Castle, Grantham.
Turnbull, James, Nurseryman, Hawick.
Turnbull, William, Assistant Forester, Bowmont Forest, Kelso.
Turner, James, Assistant Gardener, Blithefield Hall, Rugeley, Staffordshire.
Tweedie, John, Forester, Dunglass, Cockburnspath, Berwickshire.

Veitch, John, Nurseryman, Falkirk.
Veitch, William, Hedger, Arniston, Gorebridge.

Waddington, David, Crosshouse, Airdrie.
Wadds, Phillip, Gardener, Moore Abbey, Co. Kildare.
Walker, George, Forester, Collessie, Ladybank, Fife.
Walker, William, Assistant Forester, Penicuik House, Penicuik.
Wall, G. Y., jun., Exchequer Office, Durham.
Wallace, Andrew, Assistant Forester, Drumpellier, Coatbridge.
*Ward, James, Forester, Hawkhead Abbey, Paisley.
Waterer, Anthony, Nurseryman, Knaphill, Surrey.
Waters, Denis, Forester, Kelburn Castle, Largs.
Waterson, A., Wood Manager, Glenart Castle, Arklow, Co. Wicklow.
Watson, John, Gardener, Stravithy, St Andrews.
Watson, William, Assistant Forester, Peth, Longtown, Cumberland.
Watson, W. J., Nursery and Seedsman, Newcastle-on-Tyne.
Watt, James, Messrs Little and Ballantyne, Nurserymen, Carlisle.

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WATT, William, Forester, Nisbet House, Dunse.
WEBSTER, David, Bangholm, Edinburgh.
WEBSTER, J., The Gardens, Gordon Castle, Fochabers.
WELSH, Duncan, Gardener, Mount Merrion, Dublin.
*WELSH, James, Nursery and Seedsman, Edinburgh.
*WELSH, William M., Nursery and Seedsman, Edinburgh.
WEST, Charles Elis, Land Steward, Cartoon, Maynooth.
WHILLIS, Alexander, Assistant Forester, Penicuik House, Penicuik.
WHITE, George, Seedsman, Paisley.
*WHITEFORD, Robert, Assistant Hedger, Bute Estate, Rothesay.
WILLIAMS, B. S., Paradise Nursery, Upper Holloway, London, N.
WILLIAMS, Robert, of Bodelwyddn, St Asaph, North Wales.
WILSON, John, Forester, Greystoke Castle, Penrith.
WILSON, John, Forester, Auchendolly, Castle-Douglas.
WILSON, John, Assistant Forester, Arniston, Gorebridge.
WILSON, John, Assistant Forester, Sudbourn Hall, Wickham Market, Suffolk.
WILSON, Peter, Forester, Whitehill, Lasswade.
*WILSON, Robert, Forester, Pewsey, Wilts.
WILSON, Stephen, 132 Union Street, Aberdeen.
WOOD, James, Factor, Haigh Hall, Lancashire.
WOOD, John, Gardener, Hatton Castle, Aberdeenshire.
WYLIE, James, Assistant Forester, Douglaston, Milngavie, Glasgow.
*WYLLIE, George, Estate Overseer, Ballogie, Aboyne.

YELLOWLEES, George, Wood Merchant.
YOUNG, John, Messrs Imrie & Son's Nurseries, Ayr.

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SUBJECTS OFFERED FOR COMPETITION DURING 1873–74.

I. For the best and approved Essay on the Pruning of Timber-trees, considered physiologically, and in relation to the production of the greatest value. (Prize of Five Guineas offered by George Reid, Nursery and Seedsman, Aberdeen.)

II. For the best and approved Essay on the Literature of Scottish Arboriculture. (Prize of Five Guineas offered by the President.)

III. For a full and complete account, from published descriptions (the authorities distinctly quoted), personal observation and experiment, of the history and present state of the cultivation in Great Britain and Ireland of *Cedrus Deodara* (*C. Libani*, and *C. atlantica*, all now classed as one species). (Special Medal, value Three Guineas, offered by the President.)

IV. For the best and approved Report on the most extensive, complete, and judiciously arranged Arboretum. (*A Medal.*)

The Arboretums described in 1872 are excluded.

V. For the best and approved Essay on the present state and future prospects of Arboriculture in the county in which the competitor resides. (*A Medal.*)

Yorkshire and Aberdeenshire are excluded, having been reported in 1873.

VI. For the best and approved Report on the conservation of Old and Remarkable Trees in Britain. (*A Medal.*)

VII. For the best and approved Report on the Drainage of Plantations, both by Open and Covered Drains. (*A Medal.*)

VIII. For the best and approved collection of Cones exhibited from and grown in the county in which the competitor resides. (*A Medal.*)

Wigtownshire is excluded, having been reported in 1873.

IX. For the best and approved collection of prepared sections of different kinds of Wood grown in the county in which the competitor resides. (*A Medal.*)

X. For the best and approved series of Geological Specimens illustrating the different rocks and formations on which Forest Trees and Shrubs grow in the county in which the competitor resides. The specimens to be accompanied by a Report. (*A Medal.*)

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XI. On the employment of Locomotive Engines in Forestry, especially for the transit of Timber, and on the working of portable saw-mills. (*A Medal.*)

XII. For the best and approved Report on the distances at which Forest Trees, coniferous and hardwood of different species, should be planted apart in different soils, altitudes, and situations. (*A Medal.*)

XIII. For an approved Report on the Plantations of which the competitor is Forester. (*Three Medals.*) One to be awarded for the best Report from each of the countries—England, Scotland, and Ireland—and competition to be confined to each country respectively.

Those counties already reported on are excluded.

XIV. For an approved Report on the management of Forests in Germany, France, or other places on the Continent. (*A Medal.*)

XV. For an approved Report on the different Ages at which the various sorts of Timber Trees usually grown in Scotland may be most profitably felled in different soils and situations. (*A Medal.*)

XVI. For an approved Report on the Diseases most incidental to Forest Trees, including those that affect the roots as well as the bark, branches, and foliage. (*A Medal.*)

XVII. For an approved Report on the results obtained by experience of Seedlings of Coniferæ, being the produce of trees grown in Britain, as compared with plants obtained from foreign-ripened seed. (*A Medal.*)

XVIII. To any Member of the Society who shall send to the Secretary from abroad, cones or seeds of Forest Trees of new or rare varieties, capable of germination and of thriving in this country. (*A Medal.*)

XIX. For an approved Essay or Report on any other subject connected with Arboriculture. (*A Medal.*)

XX. For any marked improvement on any of the Implements used in Forestry. (Models or Implements to be accompanied by a Report.) (*A Medal.*)

For conditions of Competition, see *Proceedings* of Annual General Meeting of 5th November 1873.

All Essays and Reports intended for Competition must be given in to the Secretary not later than 25th September, and all Collections of Cones, Woods, and Geological Specimens not later than 25th October 1874—*each bearing a motto, and accompanied by a separate sealed envelope bearing the same motto outside, and containing a card with the name and address of the Author.*

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Abstract of the Laws of the Scottish Arboricultural Society, as amended to November 1873.

The object of the Society shall be the promotion of the science of Arboriculture in all its branches, by periodical meetings of the Members for the reading of Papers; by offering Prizes for Essays and Reports on the Practical operations of Forestry, and publication of the same; and by such other means as may be found advisable.

The Society shall consist of the following classes of Members:—1. Proprietors, Factors, Nurserymen, and others, paying an annual subscription of Half-a-Guinea; 2. Head-Foresters, and others, paying an annual subscription of Five Shillings; 3. Assistant Foresters, and others paying an annual Subscription of Three Shillings.

Any Member may become a Life Member by compounding for his annual subscriptions by a single payment—those of the First Class paying Five Guineas; and those of the Second and Third Classes, Three Guineas.

The Society shall elect a limited number of Honorary Members,—gentlemen who have acquired eminence in the Science of Arboriculture, or who are otherwise deemed worthy.

All annual Subscriptions shall be payable in advance, at the Annual General Meeting in November.

In addition to the annual subscriptions above stipulated, the Society shall receive, from those friendly to its objects, Donations of larger or smaller amount.

A Candidate for admission into the Society must be recommended by at least one Member, and shall, on payment of his annual subscription, be immediately admitted a Member of the Society, subject to the revision of the first General Meeting thereafter. Any Member of the Society introducing a New Member shall be held responsible for the first year's subscription of such party.

The affairs of the Society shall be conducted by a President, five Vice-Presidents, Secretary, Treasurer, Auditor, and fifteen Councillors—these office-bearers to be elected annually at the General Meeting in November; the three Councillors at the top of the list to go out annually, but one to be eligible for re-election.

A General Meeting of the Members shall be held on the first Wednesday and Thursday of November annually, for the election of New Members, the appointment of Office-Bearers, awarding of Prizes, the reading of Papers, Discussion on selected subjects, &c.

JOHN SADLER,
Secretary.

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OFFICE-BEARERS FOR 1873-74.

PRESIDENT.

HUGH CLEGHORN, of Stravithy, M.D., F.R.S.E.

VICE-PRESIDENTS.

WELLWOOD H. MAXWELL, of Munches.
ROBERT HUTCHISON, of Carlowrie, F.R.S.E.
JOHN GRANT THOMSON, Wood Manager, Grantown, Strathspey.
ROBERT FOULIS, Forester, Fordel, Fife.
WILLIAM GILCHRIST, Forester, Cluny Castle, Aberdeen.

COUNCIL.

JOHN ANDERSON, Nurseryman, Perth.
GEORGE REID, Nursery and Seedsman, Aberdeen.
ROBERT BROUGH, Forester, Balnagowan, Ross-shire.
JOHN M'LAREN, Forester, Hopetoun, South Queensferry.
HUGH FRASER, Stanwell Nursery, Edinburgh.
DAVID MITCHELL, Nurseryman, Edinburgh.
JOHN M'GREGOR, Forester, Ladywell, Dunkeld.
ALEXANDER RICHARDSON, Land Steward, Arniston, Gorebridge.
JAMES MOFFAT, Forester, Newbattle Abbey, Dalkeith.
JAMES SMITH, Forester, Donibristle, Fife.
Professor BALFOUR, M.D., F.R.S., University, Edinburgh.
WILLIAM M'CORQUODALE, Forester, Scone, Perth.
WILLIAM THOMSON, Deputy-Surveyor, H.M. Chopwell Woods, Durham.
JOHN ALLAN, Forester, Dalmeny Park, South Queensferry.
JAMES MICHIE, Forester, Wemyss Castle, Kirkcaldy.

SECRETARY.

JOHN SADLER, F.R.Ph.S., Lecturer on Botany and Zoology in the Royal High School, and Assistant to the Professor of Botany in the University, Edinburgh.

TREASURER.

THOMAS METHVEN, of Messrs T. Methven & Sons, Nursery and Seedsmen, 15 Princes Street, Edinburgh.

AUDITOR.

JOHN ORD MACKENZIE, of Dolphinton, W.S.

JUDGES.

WILLIAM GILCHRIST (Convener), Forester, Cluny Castle, Aberdeen.
JAMES RAIT, Forester, Castle Forbes, Aberdeen.
WILLIAM GOUGH, Wood Manager, Wykeham, York.

COMMITTEE ON TRANSACTIONS.

The Secretary (Mr SADLER), *Editor*, with Dr CLEGHORN, Mr HUTCHISON, and Mr WILLIAM GORRIE, as a Consulting Committee.

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GENERAL ABSTRACT OF THE ACCOUNTS

OF THE SCOTTISH ARBORICULTURAL SOCIETY

For the Year ending 31st October 1874.

CHARGE.

To Balance on hand,	£7	10	0
,, David Mitchell (Special Prize),	5	5	0
,, Received for Copies of Transactions Sold,	6	4	7½
,, Interest on Sinking Fund Account,	2	5	4
,, Do. on Ordinary Account,	0	9	0
,, Annual Subscriptions,	97	7	0
,, Arrears Recovered,	39	0	6
,, Life Membership Subscriptions,	24	3	0
,, Balance due Bank,	13	18	2
	£196	2	7½

DISCHARGE.

By Printing and Publishing Transactions,	£76	8	0
,, Advertising, Stationery, &c.,	4	3	0
,, Prizes and Medals,	13	9	0
,, Secretary's Salary,	25	0	0
,, Expenses connected with Annual Meeting,	3	2	6
,, Postages, &c.,	13	15	4
,, Paid over to Capital Account,	29	8	0
,, Balance due Bank last year,	25	15	11
,, Interest,	0	1	3
,, Balance on hand,	4	19	7½
	£196	2	7½

CAPITAL OR SINKING FUND ACCOUNT.

CHARGE.

To Balance, including 7s. 9d. interest,	£48	17	9
,, Received Life Membership Subscriptions from Ordinary Account,	24	3	0
,, Paid to Account of Sum due Capital Account,	5	5	0
,, Interest on Deposit Receipts,	1	17	7
	£80	3	4

DISCHARGE.

By Deposit Receipt,	£77	18	0
,, Interest paid over to Ordinary Account,	2	5	4
	£80	3	4

EDINBURGH, 3*d November* 1874.—Having examined the foregoing Account of Charge and Discharge, and the relative Capital or Sinking Fund Account between the Scottish Arboricultural Society and their Treasurer, Mr Thomas Methven, for the year ending 31st October 1874, and compared the same with the vouchers and instructions thereof, I have to report that the same are accurately stated and sufficiently vouched. At the close of the Account of Charge and Discharge there was a balance due by the Society to the National Bank of Scotland of Thirteen pounds eighteen shillings and twopence (£13, 18s. 2d.), and there remained in the hands of the Treasurer a sum of Four pounds nineteen shillings and sevenpence halfpenny (£4, 19s. 7½d.). The amount of the Sinking Fund is now Seventy-seven pounds eighteen shillings (£77, 18s.), which is placed on Deposit Receipt by the National Bank in name of the Society.

JOHN ORD MACKENZIE, *Auditor.*

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Scottish Arboricultural Society.

PATRON.

HER MOST GRACIOUS MAJESTY THE QUEEN.

LIST OF MEMBERS.

CORRECTED TO MARCH 1875.

* *Members who have given Subscriptions, in order to form a Capital or Sinking Fund.*

All Subscriptions are payable at the Annual General Meeting in November. Members whose Subscriptions are Two Years in Arrears are not entitled to receive the Transactions.

HONORARY MEMBERS.

BALFOUR, John Hutton, M.D., A.M., F.R.SS.L. and E., Professor of Medicine and Botany in the University of Edinburgh—*President.*

BRANDIS, Dietrich, Ph.D., Inspector-General of Forests to the Government of India.

BULLEN, Robert, Curator of Botanic Garden, Glasgow.

*HUTCHISON, Robert, F.R.S.E., of Carlowrie, Kirkliston.

LAWSON, George, LL.D., Ph.D., Professor of Natural History and Chemistry, Dalhousie College, Halifax, Nova Scotia.

M'NAB, James, F.B.S.E., Curator of the Royal Botanic Garden, Edinburgh.

LIFE MEMBERS.

ADAM, The Right Hon. W. P. of Blairadam, Kinross-shire, M.P.

BARBOUR, George F., of Bonskied, Pitlochry, Perthshire.

BELL, William, of Gribdae, Kirkcudbright.

BOSANQUET, Rev. G. H., Broom-y-Close Court, Llanwarne, Ross, Herefordshire.

BRUCE, Hon. T. C., 24 Hill Street, Berkeley Square, London, W.

CLEGHORN, Hugh, M.D., F.R.S.E., of Stravithy, St Andrews, Fife.

CRAWFORD, William Stirling, of Milton, Glasgow.

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DEWAR, Colonel A., of Vogrie, Ford.¶
DUNCAN, Alexander, of Knossington Grange, Oakham, Leicestershire.
DUNDAS, Robert, of Arniston, Gorebridge.
FISH, D. T., Hardwick, Bury-St-Edmnnds.
FITZWILLIAM, The Right Hon. The Earl, K.G., Wentworth, Rotherham Yorkshire.
GORDON, John, of Cluny Castle, Aberdeenshire.
*GOUGH, William, Wood Manager, Wykeham, York.
GRANT, John, Forester, Bridge-of-Wier, Renfrewshire.
GRANTHAM, George, Barcombe Place, Lewis, Sussex.
GRIMMOND, Alexander D., of Glenericht, Blairgowrie.
HERBERT, H. A., of Muckross, Killarney.
HOPE, H. W., of Luffness, Drem.
HUTH, Louis, of Possingworth, Hawkhurst, Sussex.
INNES, James, of Wroxton, Banbury.
KINNEAR, William Balfour, Foo-Chow, China.
LESLIE, Charles P., of Castle-Leslie, Glasslough, Ireland.
MACDONALD, Ronald, Factor, Cluny Castle, Aberdeenshire.
M'GREGOR, John, Ladywell, Dunkeld, Perthshire.
MACKENZIE, Colin J., of Portmore, Eddlestone, Peebles.
M'TIER, Alexander Walker, of Durris, Aberdeenshire.
MAXWELL, Wellwood H., of Munches, Dalbeattie.
*METHVEN, Thomas, Nursery and Seedsman, 15 Princes Street, Edinburgh.
MINTO, The Right Hon. the Earl of, Minto House, Hawick.
MOORE, Thomas, F.L.S, Curator, Botanic Garden, Chelsea.
PORTSMOUTH, The Right Hon. the Earl of, Eggesford, North Devon.
RIDLEY, G., 2 Charles Street, Berkeley Square, London, W.
ROSEBERY, The Right Hon. the Earl of, Dalmeny Park, Edinburgh.
ROSSLYN, The Right Hon. the Earl of, Dysart House, Fife.
STAIR, The Right Hon. the Earl of, Lochinch, Castle Kennedy, Wigtownshire.
*TALBERT, Peter, Forester, Glenericht, Blairgowrie.
*THOMSON, John Grant, Wood Manager, Grantown, Strathspey.
TROTTER, Colonel, R.A., the Bush, Edinburgh.
URQUHART, B. C., of Meldrum, Aberdeenshire.
WAVENEY, Lord, Flixton Hall, Bungay, Suffolk.
WEMYSS, Randolph Gordon Erskine, of Wemyss and Torry, Fife.
WILD, A. E., Assistant Conservator of Forests, Punjaub, India (6 George Street, Sheffield).
WILSON, John, F.R.S.E., Professor of Agriculture, University, Edinburgh.

ORDINARY MEMBERS.

ADIE, Alexander J., Rockville, Linlithgow.
AIRLIE, The Right Hon. the Earl of, Cortachy Castle, Forfarshire.
AITCHISON, William, Forester, Workington Hall, Cumberland.

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ALDER, Robert, Assistant Forester, Dunse Castle, Dunse.
ALEXANDER, James, Nursery and Seedsman, Edinburgh.
ALEXANDER, James, jun., 1 Waterloo Place, Edinburgh.
ALEXANDER, John.
ALEXANDER, John, Assistant Forester, Benmore House, Greenock.
ALEXANDER, William, Assistant Forester, Lochlinchart Lodge, Dingwall
ALLAN, Andrew, Rankeillor, Cupar, Fife.
*ALLAN, John, Forester, Dalmeny Park, Edinburgh.
ANDERSON, Alexander, Forester, St Fort, Newport, Dundee.
ANDERSON, Alexander, Assistant Forester, Darnaway Castle, Forres.
ANDERSON, Alexander, Gardener, Oxenford Castle, Dalkeith.
ANDERSON, Hugh, Assistant Forester, Hawkhead, Paisley.
ANDERSON, James, Bangholm Nursery, Edinburgh.
ANDERSON, James, Meadowbank, Uddingston.
ANDERSON, John, Newstead Abbey, Nottingham.
*ANDERSON, John, Nurseryman, Perth.
ANNAND, Charles Forester, Cromar Estates, Tarland, Aberdeenshire.
ANNANDALE, Robert Burns, The Gardens, Fonthill, Tisbury Wilts.
ARCHER, James, Assistant Forester, Culzean Castle, Maybole.
ARCHER, John, Assistant Forester, Culzean Castle, Maybole.
*ARCHIBALD, Thomas, Forester, Virginia, Co. Cavan, Ireland.
ARNOTT, Alexander, Hedger, East Wemyss, Fife.
ASHDOWN, Samuel Harding, Land Agent, Uppington, Wellington, Salop.
AUSTIN & M'AUSLAN, Messrs, Nursery and Seedsmen, Glasgow.

BAIGRIE, Andrew, Forester, Mote Park, Ballymurry, Co. Roscommon.
BAIGRIE, William, Forester, Echo Bank, Old Dalkeith Road, Edinburgh.
BAILLIE, William, Wood Manager, Cortachy, Kirriemuir.
BAINBRIDGE, C. M., of Dissington Hall, Newcastle-on-Tyne.
BAIRD, Joseph, Assistant Forester, Drumpellier, Coatbridge.
BALDEN, James, Forester, Lennoxlove, Haddington.
BALDEN, Joseph, Overseer, Houghton Estate, Preston.
*BALDEN, Peter G., Forester, Vaenol Park, Bangor, North Wales.
*BALDEN, William, Appleby Castle, Appleby.
*BALLANTYNE & Son, Messrs John, Nursery and Seedsmen, Dalkeith.
BALLINGALL, Robert, Factor, Eallabus, Islay, by Greenock.
*BARRIE, David, Forester, Durris, Aberdeen.
*BARRIE, James, Forester, Stevenstone House, Torrington, Devonshire.
BARTER, Frederick, Assistant Gardener.
BARTON, James, Assistant Forester, Scone, Perth.
BATY, David, Forester, Lowther Castle, Penrith.
BATY, William, Forester, Netherby, Longtown.
BAXTER, Robert, Forester, Dalkeith Park, Dalkeith.
BAXTER, William, The Gardens, Riccarton, Currie.
*BAYNE, Lewis, Forester, Kinmel Park, Abergele, North Wales.

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Begg, John, jun., Factor, Durris, Aberdeenshire.
Bell, James, Strathfieldsaye, Winchfield, Hants.
Bell, James, Forester, Newcastleton, Carlisle.
Bell, Robert, Assistant Forester, Dunse Castle, Dunse.
Bennett, Alexander, Forester.
Berry, George, Longleat, Horningsham, Warminster, Wiltshire.
Berry, Thomas Walter, Forester, Brynkinalt, Chirk, N. Wales.
Bigge, Matthew, Marsham Hatch, Ashford, Kent.
Birch, John, Assistant Gardener, Tinnchinch, Enniskerry, Co. Wicklow.
*Birnie, John, Normanby Park, Brigg, Lincolnshire.
Bissett, David, Land-Steward and Forester, Alva House, Stirling.
Bissett, William, S., Land-Steward and Forester, Moncrieffe House, Bridge of Earn, Perthshire.
Blair, Peter, Dunse.
*Boa, Andrew, Land-Steward, Dalton House, Newcastle-on-Tyne.
Boa, Andrew, jun., Assistant Factor, Blackwood, Lesmahagow.
Boa, James S. M., Agent, Fettercairn, Fettercairn.
*Borthwick, William, Forester, Dunnichen, Forfar.
Boston, Thomas C., Nurseryman, Liverpool.
Bottomer, Frederick, The Gardens, Mackree Castle, Ballisodare, Sligo.
*Brodie, James, Land-Steward, Glasslough, Armagh, Ireland.
Brough, James, Assistant Forester, Cluny Castle, Aberdeen.
Brough, Robert, Forester, Balnagowan, Tain, Ross-shire.
Brown, Andrew, Assistant Forester, Portmore, Eddleston.
Brown, J., Bretby, Burton-on-Trent.
Brown, James, LL.D., Nurseryman and Wood-Surveyor, Craigmill, Stirling.
Brown, James, Carnwath House, Carnwath.
Brown, John E., Craigmill, Stirling.
Brown, William, Land Valuator and Estate Agent (N. America).
Brown, William, Nursery and Seedsman, Stamford, Lincolnshire.
*Bruce, Peter.
Bruce, T. R., of Slogarie, Lauriestown, Castle-Douglas.
Bryan, F. G. D., Factor, Drumpellier, Coatbridge.
Brydon, John, Assistant Forester, Inverleith Nurseries, Edinburgh.
Buchan, Alexander, F.R.S.E., Secretary of the Scottish Meteorological Society, Edinburgh.
Buchan, George, Forester, Bakewell, Derbyshire.
Buchanan, Robert R., Forester, Dunse Castle, Dunse.
Burnett, James, Assistant Forester, Durris, Aberdeenshire.

Calder, Frederick, Forester, Brucklay Castle, Aberdeenshire.
Calloghin, John, Assistant Forester, Houston, Paisley.
Cameron, Alexander, Forester, Countlich Lodge, Ballinluig, Perthshire.
Cameron, Angus, Assistant Forester, Altyre, Forres.

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CAMERON, Henry, Assistant Forester, Linkwood, Elgin.
CAMERON, Hugh, Assistant Forester, Novar, Evanton Ross-shire.
*CAMERON, John, Assistant Forester, Fowlis Wester, Crieff, Perthshire
CAMERON, Robert, Forester, Galtie Castle, Mitchelstown, Tipperary.
CAMPBELL, Alexander, Forester, Gray House, Liff, Dundee.
*CAMPBELL, James, of Tillichewan Castle, Dumbartonshire.
CAMPBELL, John, Forester, Aboyne Castle, Aberdeenshire.
CAMPBELL, Peter, Assistant Forester, Invereshie, Kingussie.
CAIRNDUFF, Andrew, Forester, Abbeyleix, Queen's Co., Ireland.
CARLISLE, John, of 49 Hanover Street, Edinburgh.
CARMICHAEL, John, The Gardens, Glen Tulchan, The Cairnies, Perth.
CHALMERS, James, Duchal, Port-Glasgow.
CHAMBERS, William, of Haford, Aberystwith, Wales.
CHAPLAIN, George, Assistant Forester, Glamis Castle, Glamis, Forfarshire.
CHAPMAN, James, Assistant Forester, Grinkle Park, Saltburn-by-the-Sea, Yorkshire.
CHAPPLOW, John, Glencoin Cottage, Patterdale, Penrith.
CHRISTIE, A. D., Foreman, Heaton Park Gardens, Manchester.
CHRISTIE, David, Forester, Abington House, Lanarkshire.
*CHURNSIDE, Francis, Forester, Ladykirk, Berwickshire.
CHURNSIDE, Robert, Forester, Edlingham, Alnwick.
CLARK, David, Assistant Forester, Ury House, Stonehaven.
CLARK, George, Liberton, Edinburgh.
CLARK, J., Nursery and Seedsman, Messrs Fowler & Co., Glasgow.
*CLARK, J., Forester to the Earl of Kintore, Keith Hall, Aberdeenshire.
CLARK, James, Forester, Balvaird Cottage, Strathmiglo, Fife.
CLARK, John, The Nurseries, Cupar, Fife.
*CLARK, John, jun., Forester, Esslemont, Ellon, Aberdeenshire.
CLARK, Thomas, Beechwood Gardens, Bortly, Hants.
CLARK, William, Assistant Forester, Hawkhead, Paisley.
CLEETON, Edward, Curator, Albert Park, Middlesboro'.
*CLEGHORN, William, Forester, Ayton Castle, Ayton.
CLERK, Sir George D., Bart., Penicuik House, Penicuik.
COBBAN, John, Wood Agent, Wentworth Woods, Rotherham.
COCKBURN, William, Forester, Coats, Penicuik.
COCKER, James, Nurseryman, Aberdeen.
COOKES, Rev. W. H., Astley Rectory, near Stourport.
COOPER, George, Messrs Hurst & Son, Leadenhall Street, London.
CORBET, James, Forester, Underley Hall, Kirkby Lonsdale, Westmoreland.
*COWAN, James, Forester, Bridgend, Islay.
COWAN, Robert, Forester, Park, near Paisley.
COWE, John, Luffness, Drem.
COWIE, John, Assistant Forester, Mount Stewart, Rothesay.
COWPER, R. W., Assistant Agent, 81 High Street, Sittingbourne.
*CRABBE, James, Forester, Glamis Castle, Glamis, Forfarshire.

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*Craig, James, Bailiff, Weston Park, Shifnal, Salop.
Craig, Nathan, Cherry Cottage, Anowe Park, Birkenhead.
Craig, Richard, Forester and Gardener, Carlowrie, Kirkliston.
Craig, Robert, Levens Hall, Milnthorpe.
Cranston, G. C. Trotter, of Harvieston, Gorebridge.
Cranston, James, Assistant Forester, Floors Castle, Kelso.
*Crichton, George, 18 Princes Street, Edinburgh—*Treasurer.*
Crosbie, John, Forester and Ground Officer, Ballindalloch Castle, Ballindalloch, Banffshire.
*Cross, David G., Forester, Kylisk, Nenagh, Ireland.
Cruickshanks, Robert, Forester, Ballykilcavan, Stradbally, Queen's Co.
Cumming, Donald, Assistant Forester, Newbattle, Dalkeith.
Cunningham, D., The Gardens, Darnaway Castle, Forres.
Cunningham, John, Forester, Ardross Castle, Ross-shire.
Currie, John, Gardener, Salisbury Green, Edinburgh.
*Cutler, D., Forester, Darnaway Castle, Forres.

Dalgleish, John J., of Ardnamurchan, 8 Athole Crescent, Edinburgh.
Dallas, Joseph, Forester, Blanepant, Llandyssil, Carmarthenshire.
Dalrymple, Charles, Forester, Mitchelstown Castle, Mallow, Co. Cork.
Daniels, Peter, Forester, Slindon Hall, Arundel, Sussex.
Darien, James, Assistant Forester, Hopetoun House, South Queensferry.
*Darling, John, Forester, St Martins, Perthshire.
Davidson, George, Land-Steward, Carriden, Linlithgow.
Davidson, James, Coonoor, Neilgherries, S. India.
*Davidson, John, Forester, Aldbar, Brechin.
Davidson, John, Forester, Firth, Roslin.
*Davidson, John, Overseer and Architect, Belmont Castle, Meigle.
Davidson, Richard, Scottish Colour Works, Leith.
Davidson, W., Leager House, Chuseburn Grange, Newcastle-on-Tyne.
Dawson, James, Forester, Kilmun, Argyleshire.
*Dawson, John, Messrs J. & J. Dawson, Alloa.
Dean, Richard, Ealing, London.
Dempsey, Charles, Assistant Forester, Powerscourt, Enniskerry.
Dick, Joseph, Assistant Forester, Scone, Perth.
*Dickson, George, Stronvar, Lochearnhead.
Dickson, J., Messrs Edmonston Brothers, 9 Dame Street, Dublin.
Dickson & Sons, Messrs James, Nursery and Seedsmen, Chester.
*Dickson & Sons, Messrs James, Nursery and Seedsmen, Edinburgh.
Dickson, Thomas, Nursery and Seedsman, Chester.
Dodds, George, Overseer, Leinster Estates, Prospect House, Athy.
Don, John, Assistant Forester, Ardgowan, Greenock.
Donald, Alexander, Forester, Woodhall House, Airdrie.
Donaldson, J., Forester, Brechin Castle, Brechin.
Douglas, J., Gardener, Kilkea Castle, Mageney, Co. Kildare.

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*Dow, Thomas, Forester, Idvies, Forfar.
*Downie & Laird, Messrs, Nursery and Seedsmen, Edinburgh.
Doyle, James, Land-Steward, Heywood, Ballinakill, Queen's County.
Drummond Brothers, Messrs, Nursery and Seedsmen, Edinburgh.
Drummond & Sons, Messrs William, Nurserymen, Stirling.
Duff, James, Factor, Blackwood, Lesmahagow.
*Duff, James, Melgund, Aberlemno, Forfar.
Duff, James, Wood Manager, Bayham Abbey, Tunbridge Wells.
Dugan, Charles, Assistant Forester, Cally House, Gatehouse.
Duncan, Charles, of Woodend, Rothesay.
Duncan, John, Forester, Blanepant, Llandyssil.
Duncan, Thomas, Assistant Forester, Meldrum House, Old Meldrum.
Duncan, William, Forester, Ardgowan, Greenock.
Dunlop, Alexander, Factor, Luffness, Drem.
Dunn, David, The Gardens, Heaton Park, Manchester.
*Dunn, Malcolm, The Gardens, Dalkeith Park, Dalkeith.
Durward, Robert, Manager, Blelack, Aberdeenshire.
Dykes, John, Nursery and Seedsman, Kilmarnock.
Dykes, Thomas, Factor, Maybole, Ayrshire.

Earnshaw, L., Forester.
Eden, The Hon. R. Henley, Estate Agent, The Coigne, Minchinghampton.
Edgar, Thomas, Forester, Torry, Fife.
Elibank, Right Hon. Lord, Darnhall, Eddlestone, Peebles.
Elliot, Robert, Forester, Blairquhan, Maybole, Ayrshire.
Ewing, David, Assistant Forester, Urie House, Stonehaven.

Fairbairn, William, Land Steward, Manderston, Dunse.
Ferguson, A., Gosfield Hall, Hallstead, Essex.
Ferguson, James, Forester, Benmore and Kilmun Estates, Greenock.
Ferguson, John, Forest Department, Madras.
Ferguson, Joseph, Assistant Forester, Lambton Park, Fence Houses.
Fernie, Robert, Forester, Balcarres, Colinsburgh, Fife.
Fettes, Francis, Assistant Hedger, Ury House, Stonehaven.
Fingland, J., Forester, Drumlanrig, Thornhill, Dumfriesshire.
Finn, P. W., Forester, Borris House, Borris, Co. Carlow.
Fisher, William, Forester, Wentworth Castle, Barnsley, Yorkshire.
*Forbes, Andrew, Forester, Stracathro, Brechin.
Forbes, William, Assistant Forester, Castlecary, Denny.
Forgan, James, Wellwood Cottage, Kinnoull, Perth.
Forrest, William, Melfort Cottage, Lochgilphead.
Foulis, Robert, M.D., Cairnie Lodge, Cupar, Fife.
Foulis, Robert, Forester, Fordel, Inverkeithing, Fife.
Fowler, Archibald, The Gardens, Castle Kennedy, Stranraer.
France, Charles, Forester, Culzean Castle, Maybole, Ayrshire.

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*France, C. S., Overseer, Penicuik House, Penicuik.
*France, George, Overseer, Glenelg, Lochalsh.
France, James, Assistant Forester, Culzean Castle, Maybole, Ayrshire.
Fraser, Archibald, Forester, Skipness Castle, Tarbert, Greenock.
*Fraser, Duncan, Forester.
Fraser, James, Forester, Cabairdy, Huntly.
Fraser, James, Assistant Forester, Drumpellier, Coatbridge.
Fraser, P. Neill, Canonmills Lodge, Edinburgh.
Fraser, Hugh, Stanwell Nursery, Edinburgh.
Fraser, Simon, Forester, Haddo House, Aberdeenshire.
*Fraser, Thomas, Forester, Oriel Temple, County Louth.
Freeman, Timothy.
Frost, Philip, Gardener, Dropmore, Maidenhead.

Galloway, George, Park Hall, Oswestry, Shropshire.
*Gardiner, R., Wenalt House, Crosswood, Aberystwith, South Wales.
Gardiner, James, Forester, Hawkstone Park, Salop.
Gargan, James, Land Steward, Kells, Moynally, Co. Meath, Ireland.
Garner, John, Assistant Gardener, Cantley Hall, Doncaster, Yorkshire.
Geikie, P. M., Factor, Cortachy, Kirriemuir.
Gerrish, Edward, Wood Overseer, Maiden Bradley, Bath.
Gibb, John, Assistant Forester, Dunse Castle, Dunse.
Gibson, William, Nursery and Seedsman, 14 Lower Ormond Quay, Dublin.
Gilbert, James, Forester, Ardverikie, Kingussie.
*Gilchrist, Andrew, Forester, Ury House, Stonehaven.
Gilchrist, Daniel, Messrs Main & Co., 15 George IV. Bridge, Edinburgh.
*Gilchrist, William, Forester, Cluny Castle, Aberdeen.
Glendinning, George P., Dalmeny Park, South Queensferry.
Goodfellow, Andrew, Forester, Wolfelee, Hawick.
Goodier, George, Assistant Gardener.
Gordon, James, Assistant Forester, Botanic Garden, Edinburgh.
Gordon, John, Forester, 17 Bon-Accord Street, Aberdeen.
Gorrie, Archibald, Forester, Holkham Hall, Holkham.
*Gorrie, William, Rait Lodge, Trinity, Edinburgh.
*Gossip, James, The Nurseries, Inverness.
Gow, James, Forester, Camperdown, Dundee.
Gow, John L., Factor, Raith, Kirkcaldy.
Gow, John, jun., Assistant Agent, Grinkle Park, Saltburn-by-the-Sea.
Graham, Andrew, Agent, Ormesby House, near Middlesboro'.
Grandison, James, Assistant Forester, New Scone, Perth.
Grant, Colonel James A., C.B., C.S.I., 7 Park Square, Regent's Park, London.
Grant, Donald, Forester, Drumin, Ballindalloch.
Grant, James, Assistant Forester, Abernethy, Strathspey.
Grant, John, Assistant Forester, Abernethy, Strathspey.

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GREEN, Alexander, Assistant Forester, Culzean Castle, Maybole.
GREEN, William, Assistant Forester, Charleston, Malmesbury, Wilts.
GREER, Robert, Assistant Forester, Ardgowan, Greenock.
*GREIG, Gavin, Forester, Parkhill, Aberdeen.
GRIEVE, George, Gardener, Dalkeith.
GRIEVE, James, Messrs Dickson and Co., Nurseries, Leith Walk, Edinburgh.
*GRIGOR, John, Nurseryman, Forres.
GUTHRIE, Colonel, Carlogie House, Carnoustie.

*HALL, Peter, Forester, Huntly Lodge, Huntly.
HAMILTON, David, Forester.
HAMILTON, John B. Baillie, of Arnprior, Cambusmore, Callander.
HANDASYDE & DAVIDSON, Messrs Thomas, Nurserymen, Musselburgh.
HARDIE, A., Manager, Monboddo, Fordoun.
*HARDIE, Walter, Forester, The Hall, Norwell, Newark, Notts.
*HARLEY, Andrew, Penybout, Radnorshire.
HARROLD, George, Gardener, Mount Henrie, Queen's Co., Ireland.
HARROWER, William, Forester, Glenapp, Ballantrae, Ayrshire.
HART, Thomas, Assistant Forester, Yester, Haddington.
HARTLAND, Richard, The Lough Nurseries, Cork.
HAVELOCK, Thomas, Forester, Raby Park, Staindrop, Co. Durham.
HAVELOCK, William, Forester, Dilston, Corbridge, Newcastle-on-Tyne.
HAYMAN, John, jun., Overseer, Dumfries House, Old Cumnock.
HEALE, William, Dean Park Nurseries, Edinburgh.
HELMAN, George, Assistant Gardener.
HELMAN, William, Gardener.
HENDERSON, Alexander, The Gardens, Dalziel, Motherwell.
*HENDERSON, Archibald, Forester, Clonad Cottage, Tullamore, King's County.
HENDERSON, John, Land Steward, Knockdrin Castle, Mullingar.
HENDERSON, John, Forester, Cardoness, Gate-House, Kirkcudbrightshire.
HENDERSON, Robert, Assistant Forester, Dalmeny Park, Edinburgh.
HENDRY, David, Bangholm Nurseries, Edinburgh.
HEPBURN, James, Forester.
*HEPBURN, William, Assistant Forester, Altyre, Forres.
HERMISTON, James, Assistant Forester, Floors Castle, Kelso.
HETHERTON, Walter, Forester, Heanton, Satchville, Bedworth, N. Devon.
HILL, John, Land Steward, Whitehill, Lasswade.
HILSON, John, Assistant Forester, Floors Castle, Kelso.
*HOGARTH, James, Forester, Duthill, Strathspey.
HOGG, Thomas, Forester, Hampton Court, Leominster, Hereford.
HOOD, James, Assistant Forester, Langlee, Jedburgh.
HODD, William, Gardener, Glasslough, Ireland.
HOME, Edward, Assistant Forester, Dunse Castle, Dunse.
HOME, George, Assistant Forester, Drumlanrig, Thornhill.
HORSBURGH, James, Forester, Yester, Haddington.

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HOWIE, Charles, Eden Cottage, Largo, Fife.
HUBBARD, Egerton, M.P., of Addington Manor, Winslow, Bucks.
HUME, Andrew, Forester, Wansford, Peterborough.
*HUNTER, Patrick, Overseer, Glenarm Castle, Larne, Ireland.
HUNTER, William, Forester, Castlemilk, Glasgow.
HUSSEY, Samuel M., Estate Office, Tralee.
*HUTTON, James, Forester, Moy, Forres.

IRELAND, John, Seed Warehouse, 15 Princes Street, Edinburgh.

JAMIESON, D., Thoresby Park, Ollerton, Nottinghamshire.
JEFFREY, John, of Balsusney, Kirkcaldy, Fife.
JEFFREY, John, Forester, Craighall, Blairgowrie.
JOHNSTON, George, The Gardens, Glamis Castle, Glamis.
JOHNSTON, James.
JOHNSTON, William, Fencer, Lee, Lanark.
JOHNSTONE, Alexander, Assistant Forester, Arniston, Gorebridge.
JOHNSTONE, Alexander, Forester, Lee Castle, Lanark.
*JOHNSTONE, William, Bangholm House, Ferry Road, Edinburgh.
JOSS, John, Assistant Forester, Crathes Castle, Aberdeenshire.

*KAY, James, Forester and Hedger, Bute Estate, Rothesay.
*KEDZIE, Walter, Forester, Arundel Castle, Arundel, Sussex.
KEIR, David, Forester, Blair Athole, Perthshire.
*KEMP, John, Assistant Forester, Midmar, Aberdeenshire.
KENMARE, The Right Hon. the Earl of, Killarney House, Killarney.
KENNEDY, Duncan, Assistant Forester, Underley, Kirkby, Lonsdale.
KENNEDY, G. G. Allan, Assistant Forester, Gothic House, Morden, Surrey.
KENNEDY, John, Forester and Ground Officer, Glen Urquhart, Drumnadrochit.
KENNEDY, William, Overseer, Carradale, Greenock.
KIDD, James, Assistant Forester, Morden Park, Surrey, S.W.
*KINGHORN, Adam, Forester, Rochsoles, Airdrie.
KINGHORN, James, Assistant Forester, Dunse Castle, Dunse.

LAING, James, Assistant Forester, Penicuik House, Penicuik.
LAMBERTON, Hugh, Forester, Orwell Park, Bucklesham, Ipswich.
LAMONT, John, Inverleith Nurseries, Edinburgh.
LANDRETH, Burnet, of Bloomsdale, near Philadelphia, U.S.
*LAUDER, William, Messrs Carr & Co., Timber Yard, Walker-on-Tyne.
LAURISTON, Alexander, Assistant Forester, Meldrum House, Old Meldrum.
LEGGAT, Alexander, Assistant Forester, Abernethy Nursery, Strathspey.
LEIGH, William, of Woodchester Park, Stonehouse, Gloucestershire.
LEISHMAN, Richard, Forester, Muncaster Castle, Ravenglass, Cumberland.

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LEMON, Thomas, The Gardens, Convamore, Ballyhoolly, Ireland.
LENOX, William, Forester, Keir, Dunblane.
LESLIE, The Hon. George Waldegrave, Leslie House, Leslie, Fife.
LIDDELL, Rev. J. R., The Manse, Kirkliston.
LINKSTONE, James, Assistant Forester, Dalmeny Park, Edinburgh.
LITTLE, Alexander, Forester, Relugas, Dunphail, Morayshire.
LORAINE, Edward, The Riding Mill, Northumberland.
LOTHIAN, The Most Hon. the Marquis of, Pinnelheugh House, Jedburgh.

M'AINSH, Robert, Assistant Forester, Castle Menzies, by Aberfeldy.
M'ALISTER, Alexander, Rossie Priory, Dundee.
MACBETH, J., Land Steward, Stobhall, Perth.
M'CALLUM, James Thyne, Nursery and Seedsman, 60 Buchanan Street, Glasgow.
M'CALLUM, G. K., of Braco Castle, Braco.
M'COLL, James, Forester, Clifton Park, Kelso.
*M'CORQUODALE, Donald, Forester, Dunrobin Castle, Golspie.
M'CORQUODALE, D. A., Assistant Factor, Panmure, Forfarshire.
*M'CORQUODALE, William, Forester and General Wood Surveyor, Jeanie Bank, Perth.
M'CREATH, Hugh, Assistant Forester, Culzean, Maybole, Ayrshire.
M'CUTCHEON, Robert, Assistant Forester, Cawdor Castle, Nairn.
M'DONALD, Alexander, Forester, Drumpellier, Coatbridge.
M'DONALD, Charles, Superintendent, Phœnix Park, Dublin.
M'DONALD, Donald, Assistant Forester.
M'FADYEN, Duncan, Forester, Dunmore, Stirling.
M'GRATH, Patrick, Assistant Forester, Galtie Castle, Mitchelstown, Co. Tipperary.
M'GREGOR, Archibald, Assistant Forester.
M'HARDY, Charles, Forester, Castle Newe, Strathdon.
M'HATTIE, John, Seedsman, Northgate, Chester.
M'INTOSH, Angus, Forester.
MACKAY, John, West Dean Estate, Chichester.
M'KAY, James, Forester, Whittinghame, Prestonkirk.
M'KAY, Thomas, Forester, 3 Harbour Terrace, Aberystwith, S. Wales.
M'KEITH, Archibald, West Coates Nursery, Edinburgh.
MACKENZIE, Alexander, Warriston Nurseries, Edinburgh.
M'KENZIE, Donald F., Forester, Meldrum House, Aberdeenshire.
MACKENZIE, James, 1 George IV. Bridge, Edinburgh.
MACKENZIE, J. Ord, W.S., of Dolphinton, 7 Royal Circus, Edinburgh—*Auditor.*
M'KENZIE, K. Stewart, of Brahan Castle, Dingwall.
MACKIE, John, Assistant Forester, Ballogie, Aboyne.
MACKINTOSH, R. T., Nursery and Seedsman, Edinburgh.
M'LAGAN, John, Forester, The Cairnies, Methven, Perthshire.

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*M'Laren, Hugh.
M'Laren, John, Ballencrieff, Drem.
*M'Laren, John, Forester, Hopetoun House, South Queensferry.
*M'Laren, John, Forester, Darnhall, Eddlestone, Peebles.
M'Laren, Peter, Forester, Lilleshall, Newport, Salop.
*M'Laren, Peter, Sub-Agent, Sittenham, York.
M'Lean, Andrew, Assistant Forester, Rutherford, Kelso.
M'Lean, John, Forester, Swainston, near Newport, Isle of Wight.
M'Lean, Malcolm, The Gardens, Gosford, Drem.
M'Lean, William, Forester, Eglinton Castle, Irvine.
M'Leay, William, The Gardens, Eaglehurst, Fawley, Southampton.
M'Lellan, Duncan, Superintendent of Parks, Glasgow.
M'Leod, Alexander, Forester, Gosford, Drem.
M'Leod, Angus, The Gardens, Newbattle Abbey, Dalkeith.
M'Leod, J., Nurseryman, Crieff, Perthshire.
M'Millan, Samuel, Assistant Forester, Dunse Castle, Dunse.
M'Nab, Malcolm, of 59 North Hanover Street, Edinburgh.
Macnaughton, Alexander, S.S.C., Arranmore Villa, Stanley Road, Edinburgh.
M'Naughton, Archibald, Forester, Williamwood, Cathcart, Glasgow.
M'Neill, D., Timber Agent, Kirriemuir.
M'Neill, James, Forester, Abercairney, Crieff.
M'Neill, James, Forester.
M'Rae, John, Forester, Coplawhill Nursery, Glasgow.
M'Rae, Robert, Assistant Forester, Cullen House, Cullen.
M'Ritchie, T. E., W.S., 4 Gayfield Square, Edinburgh.
Main, John, Forester, Bryan Hall, Ferrybridge, Yorkshire.
Main & Co., Messrs A. & J., Wire Fence Manufacturers, 7 Renfield Street, Glasgow.
Maitland, Sir A. C. R., Bart, M.P., Cliftonhall, Ratho.
Maitland, Wiliam, Assistant Forester, Keith Hall, Aberdeenshire.
Malcolm, George, Bangholm Nursery, Edinburgh.
Manson, Robert, The Nurseries, Kelso.
Manton, William, Assistant Forester, Dunse Castle, Dunse.
Marr, John, Assistant Forester, Darnaway Castle, Forres.
*Marshall, J., Forester, Lambton Park, Fence Houses, Durham.
Marshall, James, Forester, Preston, Dunse.
Marshall, James, Assistant Forester, Scone, Perth.
Marshall, Robert, Forester, Horton Manor, near Epsom.
Marshall, Robert, Assistant Forester, Ardgowan, Greenock.
Martin, George, Forester, Dunecht House, Aberdeen.
Martin & Sons, Messrs, Nurserymen, Cottingham, Hull.
Mathieson, Donald, Meikleour, Perth.
Maxton, Robert, Forester, Strathallan Castle, Auchterarder.
Melrose, John, Wood Merchant.

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MELROSE, William, Forester, Byram Hall, South Mitford.
MENZIES, George, Agent, Trentham, Stoke-on-Trent.
MENZIES, William, Forester, Craigton Cottage, Causewayhead, by Stirling.
METHVEN, John, Nursery and Seedsman, Edinburgh.
*MICHIE, Christopher Young, Forester, Cullen House, Cullen, Banffshire.
*MICHIE, James, Forester, Wemyss Castle, Kirkcaldy.
MIDDLEMASS, Archibald, Forester, Dunans House, Colintraive, Greenock.
MILNE, James, Forester, Glenmuick, by Ballater.
*MILLER, John, Forester, Ochtertyre, Stirling.
*MITCHELL, David, Nurseryman, Edinburgh.
MITCHELL, Forbes, of Thainstone, Kintore.
MITCHELL, Garlies, Nurseryman, Stranraer.
MITCHELL, James, Aldie, Kinross.
MITCHELL, James, Forester, Knossington Grange, Oakham, Leicestershire.
MOFFAT, Adam, Forester, Hindlip Hall, Worcester.
MOFFAT, Henry, Forester, Monkray, Whitehaven, Cumberland.
MOFFAT, James, Forester, Newbattle Abbey, Dalkeith.
MOFFAT, John, Forester, Kimmerghame, Dunse.
MORRISON, John, Coney Park Nursery, Stirling.
MORRISON, R., Nurseryman, Elgin.
MUIR, William, of Inistrynich, Inveraray, Argyleshire.
*MUIRHEAD, John, Forester, Bicton, Budleigh, Salterton, Devonshire.
MUNRO, James, Forester, Invermorriston, Inverness-shire.
MUNRO, James, Assistant Forester, Darnaway Castle, Forres.
MUNRO, John, Assistant Forester, Cluny Castle, Aberdeen.
MURRAY, David, Forester, Dunira, Perthshire.
MYLES, James, Forester, Portmore, Eddlestone, Peebles.

NEIL, Archibald, Forester, West Grange, Culross.
NEWBIGGING, Alexander T., Nurseryman, Dumfries.
NICOL, W., Assistant Forester, Loudon Castle, Galston.
NICOL, William, Forester, Pitcaple, Aberdeenshire.
NICOLL, Alexander, The Gardens, Clova, by Lumsden, Aberdeenshire.
NOTMAN, David, Nursery Foreman, Dean Park Nurseries, Edinburgh.

*OGILVY, David, Assistant Forester, Cortachy, Forfar.
O'NEILL, Richard, Auctioneer, Old Castle, Co. Meath.
OLLIER, John Clement, of Beauchamp House, Enfield, Middlesex.
*ORMISTON & RENWICK, Messrs, Nursery and Seedsmen, Melrose.

*PALMER & SON, Messrs John, Nurserymen, Annan.
*PARKER, James, Forester, Belvoir Castle, Grantham.
PARKER, Robert A., Nursery and Seedsman, Lanark.
*PATERSON, Andrew, Surveyor, Exton, Oakham, Rutland.
PATERSON, Charles, Factor, Castle Menzies, Aberfeldy, Perthshire.

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PEEBLES, Andrew, Highclere Castle, Newbury, Berks.
PENDER, John, M.P., of Minard Castle, Argyllshire.
PENDREIGH, John, Assistant Forester, Port Bannatyne, Rothesay.
PHILIP, John, Wood Merchant, Bonnyrigg, Lasswade.
*PHILIP, Robert, Minsterley, Shrewsbury.
PIERSON, Joshua, Forester, Old Shields, Airdrie.
PIRIE, John, Forester, Blackhall, Aberdeenshire.
PLATT, Major, Langairfechan, near Bangor.
POWERSCOURT, The Lord Viscount, Powerscourt, Enniskerry, Co. Wicklow.
POWNER, George, Forester, Willey Hall, Broseley, Shropshire.
POWNER, Thomas, British Workman's Rooms, Wellington, Shropshire.
PRESSLEY, D., Gardener, Knockmaroon, Chapelizod, Dublin.
PRICE, J., Forester, Garnstone Castle, Hereford.

RAIT, James, Forester, Castle Forbes, Whitehouse, Aberdeen.
RAMSDEN, Sir J., Bart., Buckden, Skipton, York.
RANKINE, Thomas, Nurseryman, Hamilton.
RATTRAY, Thomas, Forester, Westonbilt House, Tetbury, Gloucestershire
*RAVENSCROFT, Edward, "Farmer" Office, India Buildings, Edinburgh.
RAWLENCE, James, of Bulbridge, Wilton.
REA, Archibald Henry, Assistant Forester, Ury House, Stonehaven.
*REID, George, Nursery and Seedsman, Aberdeen.
REID, James, Assistant Forester, Dalkeith Park, Dalkeith.
RENTON, James, Forester and Land-Steward, Cleghorn, Lanark.
RICHARDSON, Adam, Assistant Forester, Arniston, Gorebridge.
*RICHARDSON, Alexander, Land-Steward, Arniston, Gorebridge.
RIGHY, William, Messrs King & Co., 45 Pall Mall, London.
RINTOUL, Henry, The Gardens, Hawick Hall, Alnwick.
RITCHIE, Henry, Eridge Castle, Tunbridge Wells.
*RITCHIE, Walter, Forester, Dinnas Mawddwy, Shrewsbury, N. Wales.
ROBERTSON, D., Albert Hotel, Hanover Street, Edinburgh.
ROBERTSON, David, Estate Manager, Curraghmore, Portlaw, Waterford.
ROBERTSON, George, Forester, Benmore, Kilmun, Greenock.
ROBERTSON, George, jun., Assistant Forester, Thirlstane Castle, Lauder.
ROBERTSON, James.
ROBERTSON, James, Forester, Drummond Castle, Crieff.
ROBERTSON, John.
ROBERTSON, John, Forester, Minto House, Hawick.
ROBERTSON, John, Assistant Forester.
ROBERTSON, Robert, Forester, Markree Castle, Collooney, Co. Sligo.
ROBERTSON, Peter, Gordon Castle, Fochabers, Morayshire.
ROBERTSON, P. S., Nursery and Seedsman, Edinburgh.
ROBERTSON, Thomas, Forester.
ROBERTSON, William W., Forester, Blinkbonny, Earlston.
*ROBSON, Alexander, Duchfour Woods, Lochend, Inverness.

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ROBSON, David, Assistant Forester, Arthur Stone, by Meigle.
ROBSON, John, Forester, 15 Supple Street, Bishopfields, Chestrie.
ROBSON, Ralph, Nursery and Seedsman, Hexham.
RODGER, Hugh, Factor, Cleland, Motherwell.
ROSS, Archibald, Overseer, Skipton Castle, Skipton-in-Craven, Yorkshire.
RULE, John, Forester, Monymusk, Aberdeenshire.
*RUSSELL, John, Craigie, Ayr.
RUSSELL, Robert, Forester, Mostyn, Holywell, N. Wales.
RUST, Joseph, The Gardens, Eridge Castle, Tunbridge Wells, Kent.
*RUTHERFORD, Andrew, Forester, Bowmont Forest, Kelso.
*RUTHERFORD, James, Forester, Linthaugh, Jedburgh.
*RUTHERFORD, James, Agent, Kirkleatham, Redcar, Yorkshire.
RUTHERFORD, John, Assistant Forester, Linthaugh, Jedburgh.
RUTHERFORD, Robert, Manager, Invershie, Kingussie.
RUTHERFORD, Thomas, Hothfield, Ashford, Kent.

*SADLER, John, F.R.Ph.S., Experimental Cottage, Edinburgh—*Secretary*.
*SAMSON, John, Forester, Abernethy, Strathspey.
*SANDBACH, Henry R., Hafodunos, Llanrwst, Denbighshire.
SCARTH, T. W., Land Agent, Keverstone, Staindrop, Darlington.
SCOTT, Adam, Forester, Southwick Park, Fareham, Hants.
SCOTT, Andrew, Assistant Forester.
*SCOTT, D., Wood Manager, Darnaway Castle, Forres.
*SCOTT, David, Forester and Land-Steward, Broadford, Limerick.
SCOTT, John, Forester.
*SCOTT, John W., Delgany, County Wicklow, Ireland.
SCOTT, Walter, Forester, Oxnam, Jedburgh.
SCRIMGEOR, James, Under Forester, Altyre, Forres.
SEATON, Allan, Assistant Forester, Curraghmore, Portlaw, Co. Waterford.
SEDGWICK, A. O., of 38 High Street, Watford, Herts.
SERVICE, George, Assistant Forester, Dunse Castle, Dunse.
SERVICE, James, Assistant Forester, Dunse Castle, Dunse.
SERVICE, Robert, Assistant Forester, Dunse Castle, Dunse.
SHAND, James, Gardener, Meldrum House, Aberdeenshire.
SHANKS, John, Forester, Kildrummy Castle, by Mossat.
SHEPPARD, John, Tweedside Cottage, Roehampton, Surrey.
SIM, William, Nurseryman, Forres.
SIME, John, Timber Merchant, Rafford, Forres.
*SIMPSON, J., Forester, Alloa Park, Alloa.
SIMPSON, Peter, Assistant Forester, Daughty Mill, Kirkcaldy.
*SIMPSON, Thomas, Forester, Glenferness, Nairnshire.
SINTON, David, Assistant Forester, Charlton, Malmesbury, Wilts.
SINTON, J., Forester, Stourhead, Bath.
SINTON, John, Forester, Charlton, Malmesbury, Wilts.
SKELDON, John, Assistant Forester, Dunse Castle, Dunse.

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SKIRVING, Archibald, Forester, Duncombe Park, Helmesley, York.
SKIRVING, John Finlay, Assistant Forester, Duncombe Park, Helmesley.
SKIRVING, William, Nursery and Seedsman, Liverpool.
*SLATER, Andrew, Forester, Loftus, Saltburn-by-the-Sea, Yorkshire.
SLATER, Andrew, jun., Forester, Penicuik House, Penicuik.
*SMART, A. H.
SMITH, A., Factor, Douglas Castle, Lanarkshire.
SMITH, G. B., Wire Fence Manufacturer, 56 West Regent St., Glasgow.
*SMITH, James, Forester, Donibristle, Aberdour, Fife.
SMITH, James, The Gardens, Mentmore, Leighton-Buzzard, Buckinghamshire.
SMYTH, John B., Forester, Melville, Ladybank, Fife.
SMITH, John Crombie, Assistant Forester, Drummond Castle, Crieff.
SMITH, Thomas, Nurseryman, Stranraer.
SMITH, W. Baxter, Messrs Little & Ballantyne, Nursery and Seedsmen, Carlisle.
SMITH & SIMMONS, Messrs, Nursery and Seedsmen, Howard St., Glasgow.
*SMITH & SON, Messrs William, Nursery and Seedsmen, Aberdeen.
SOLLY, Professor Edward, F.R.S., Parkstone, near Poole.
SPENCE, Charles, Assistant Forester, Drumpellier, Coatbridge.
STALKER, Donald, Assistant Forester.
STAPYLTON, Major, Myton Hall, Borobridge, Yorkshire.
STARK, John, Assistant Forester, Woodhall, Airdrie.
STEELE, David, Forester, Skene House, Aberdeen.
STEPHEN, James, Forester, Dochfour, Inverness.
STEPHEN, John, jun., Assistant Forester, Cluny Castle, Aberdeen.
STEVENSON, Alexander, Forester, Cahir Estates, Co. Tipperary.
STEVENSON, David, Forester, Kelly, Wemyss Bay, Greenock.
*STEVENSON, James, Forester, Cobham Park, Surrey.
STEWART, Alexander, Edinburgh.
STEWART, Alexander, Forester, Gringle Park, Saltburn-by-the-Sea, Yorkshire.
STEWART, D., Manager, Dalnavart, Aviemore.
STEWART, James, Assistant Forester, Drumpellier, Coatbridge.
STEWART, John, Forester, Blair Athole, Perthshire.
STEWART, John, Forester, Castlecary, Denny.
STEWART, Peter, Gardener and Forester, Castle Wellan, Co. Down.
STEWART, William, Land-Steward, Dalhousie Castle, Lasswade.
STEWART, William, Nurserymen, Dundee.
STEWART, William, Assistant Forester, Underley Hall, Kirkby.
STEWART, William, Assistant Forester, Logie Almond, Perth.
STRACHAN, W. B., Manager, Dalkeith Nurseries, Dalkeith.
STRANG, Alexander, Forester, Rendlesham Hall, Woodbridge, Suffolk.
STRANG, William, Assistant Forester, New Scone, Perth.
STUART, John, Forester, Castle Grant, Strathspey.

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STUART, Lewis A. G., Forester, Netherdale House, Turriff.
*STUART, William, Forester.
STUART & MEIN, Messrs, Nurserymen, Kelso.
SUTTIE, James, Evington, Ashford, Kent.
SWAN, R. G., Auctioneer, Dunse.
SWINTON, A. Campbell, LL.D., F.R.S.E., of Kimmerghame, Dunse.
SYME, David, 1 George IV. Bridge, Edinburgh.
SYMON, John, Forester, Cawdor Castle, Nairn.
SYMON, Peter, Forester, Forres.

TAIT, David, Forester, Owston Park, Doncaster, Yorkshire.
TAIT, Walter, Seedsman, 45 Chapel Street, Dublin.
TAYLOR, David, Barskimming, Mauchline.
TAYLOR, George, Forester, Monymusk, Aberdeenshire.
TAYLOR, George, Nursery and Seedsman, Inverurie.
THOMSON, James Scott, Strathallan Castle, Auchterarder.
THOMSON, Lockhart, S.S.C., 22 Coates Crescent, Edinburgh.
THOMSON, Thomas, Forester, Penicuik House, Penicuik.
THORNTON, Thomas, Heatherside, Frimley, Surrey.
TIVENDALE, William, Forester, Houston, near Paisley.
TOMLINSON, J., Brocklesby Park, Ulceby.
TOMLINSON, Wilson, Assistant Forester, Belvoir Castle, Grantham.
TURNBULL, James, Nurseryman, Hawick.
TURNBULL, William, Assistant Forester, Bowmont Forest, Kelso.
TURNER, James, Assistant Gardener, Blithefield Hall, Rugeley, Staffordshire.
TWEEDIE, John, Forester, Dunglass, Cockburnspath, Berwickshire.

VEITCH, John, Nurseryman, Falkirk.
VEITCH, William, Hedger, Arniston, Gorebridge.
WADDINGTON, David, Crosshouse, Airdrie.
WADDS, Phillip, Gardener, Moore Abbey, Co. Kildare.
WALKER, George, Forester, Collessie, Ladybank, Fife.
WALKER, William, Assistant Forester, Penicuik House, Penicuik.
WALL, G. Y., jun., Exchequer Office, Durham.
WALLACE, Andrew, Assistant Forester, Drumpellier, Coatbridge.
*WARD, James, Forester, Hawkhead Abbey, Paisley.
WATERER, Anthony, Nurseryman, Knaphill, Surrey.
WATERS, Denis, Forester, Kelburn Castle, Largs.
WATERSON, A., Wood Manager, Glenark Castle, Arklow, Co. Wicklow.
WATSON, John, Gardener, Stravithy, St Andrews.
WATSON, William, Assistant Forester, Peth, Longtown, Cumberland.
WATSON, W. J., Nursery and Seedsman, Newcastle-on-Tyne.
WATT, James, Messrs Little and Ballantyne, Nurserymen, Carlisle.
WATT, William, Forester, Nisbet House, Dunse.

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WEBSTER, Angus, D., Assistant Forester, Penicuik House, Penicuik.
WEBSTER, David, Bangholm, Edinburgh.
WEBSTER, J., The Gardens, Gordon Castle, Fochabers.
WEBSTER, John Blaikie, Verner's Bridge, Moy, Ireland.
WELSH, Duncan, Gardener, Mount Merrion, Dublin.
*WELSH, James, Nursery and Seedsman, Edinburgh.
*WELSH, William M., Nursery and Seedsman, Edinburgh.
WEST, Charles Elis, Land-Steward, Cartoon, Maynooth.
WHILLIS, Alexander, Assistant Forester, Penicuik House, Penicuik.
WHITE, George, Seedsman, Paisley.
*WHITEFORD, Robert, Assistant Hedger, Bute Estate, Rothesay.
WILLIAMS, B. S., Paradise Nursery, Upper Holloway, London, N.
WILLIAMS, Robert, of Bodelwyddn, St Asaph, North Wales.
WILSON, John, Land-Steward and Forester, Borthwickbrae, Hawick.
WILSON, John, Forester, Greystoke Castle, Penrith.
WILSON, John, Forester, Auchendolly, Castle-Douglas.
WILSON, John, Assistant Forester, Arniston, Gorebridge.
WILSON, John, Forester, Sudbourn Hall, Wickham Market, Suffolk.
WILSON, Peter, Forester, Whitehill, Lasswade.
*WILSON, Robert, Forester, Pewsey, Wilts.
WILSON, Stephen, 132 Union Street, Aberdeen.
WOOD, James, Factor, Haigh Hall, Lancashire.
WOOD, John, Gardener, Hatton Castle, Aberdeenshire.
WORMALD, J. D., W.S., 93 Princes Street, Edinburgh.
WYLIE, James, Assistant Forester, Douglaston, Milngavie, Glasgow.
*WYLLIE, George, Estate Overseer, Ballogie, Aboyne.

YELLOWLEES, George, Wood Merchant, St Boswells.
YOUNG, James, of Durris, by Aberdeen.
YOUNG, John, Messrs Imrie & Son's Nurseries, Ayr.

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SUBJECTS OFFERED FOR COMPETITION DURING 1874–75.

I. For the best and approved Essay on the Pruning of Timber-trees, considered physiologically, and in relation to the production of the greatest value. (Prize of Five Guineas offered by George Reid, Nursery and Seedsman, Aberdeen.)

II. For a full and complete account, from published descriptions (with authorities distinctly quoted), personal observation and experiment, of the history and present state of the cultivation in Great Britain and Ireland of *Cedrus Deodara* (*C. Libani*, and *C. atlantica*, all now classed as one species). (Special Medal, value Three Guineas, offered by Dr Cleghorn.)

III. For the best and approved Report on the most extensive, complete, and judiciously arranged Arboretum. (*A Medal.*)
The Arboretums reported on in 1872 are excluded.

IV. For the best and approved Essay on the present state and future prospects of Arboriculture in the county in which the competitor resides. (*A Medal.*)
Yorkshire, Hampshire, and Aberdeenshire are excluded, having been reported on.

V. For the best and approved Report on the Old and Remarkable Trees on the estate on which the competitor resides; correct measurements of the circumference of the trunks, at 1 foot and 5 feet from the ground, must be given; also height of tree, spread of branches, &c. Photographs are desirable. (*A Medal.*)

VI. On the Economic Value of the Effects of the Gale of October 21, 1874, upon Trees of Position, and Woods in Scotland, with Statistics of the details of these Losses. (*A Medal.*)

VII. For the best and approved collection of Cones exhibited from and grown in the county in which the competitor resides. (*A Medal.*)
Each cone (or series of cones of one species) must be accompanied by a label giving the name of the species, the estate and county where produced, and the year grown. The Prize collection to become the property of the Society.
Wigtownshire is excluded, having been reported in 1873.

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VIII. For the best and approved collection of prepared sections of different kinds of Wood grown in the county in which the competitor resides. (*A Medal.*)

Each section must have a label attached, bearing the name of the wood and the estate and county where grown. The Prize collection to become the property of the Society. The successful competitors for woods in 1872 cannot compete.

IX. For the best and approved series of Geological Specimens illustrating the different rocks and formations on which Forest Trees and Shrubs grow in the county in which the competitor resides. The specimens to be accompanied by a Report. (*A Medal.*)

The successful collection to be the property of the Society. Buteshire, having already been reported on, is excluded.

X. For the best and approved Report on the distances apart at which Forest Trees, of different species, should be planted in different soils, altitudes, and situations. (*A Medal.*)

XI. For an approved Report on the Plantations of which the competitor is Forester. (*Three Medals.*) One to be awarded for the best Report from each of the countries—England, Scotland, and Ireland—and competition to be confined to each country respectively. Reporters must state the extent of plantations under their charge, the kind of timber grown, soil, situation, management, age, &c.

The counties already reported on are excluded.

XII. For an approved Report on the management of Forests in Germany, France, or other places on the Continent. (*A Medal.*)

Special reference to be made to any appliances or modes of culture and treatment not generally adopted in this country, but followed in such arboricultural schools as those of Nancy and Hanover, and elsewhere abroad. Foreigners are specially invited to compete.

XIII. For an approved Report on the different Ages at which the various sorts of Timber Trees usually grown in Scotland may be most profitably felled in different soils and situations. (*A Medal.*)

XIV. For an approved Report on the Diseases most incidental to Forest Trees, including those that affect the roots as well as the bark, branches, and foliage. (*A Medal.*)

XV. For an approved Report on the results obtained by experience of Seedlings of Coniferæ, being the produce of trees grown in Britain, as compared with plants obtained from foreign-ripened seed. (*A Medal.*)

XVI. To any Member of the Society who shall send to the Secretary from abroad, cones or seeds of Forest Trees of new or rare species or varieties, capable of germination and of thriving in this country. (*A Medal.*)

To be awarded when fifty of any sort, or fifty plants in all, have been successfully raised. These plants to be the property of the

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Society, and to be balloted for amongst Members intimating their desire to have them. The packages to be delivered free of cost to the Society at any British port.

XVII. For an approved Essay or Report on any subject connected with Arboriculture. (*A Medal.*)

XVIII. For any marked advantageous improvement on any of the Implements used in Forestry. (Models or Implements to be accompanied by a Report.) (*A Medal.*)

For conditions of Competition, see *Proceedings* of Annual General Meeting of 4th November 1875.

All Essays and Reports intended for Competition must be given in to the Secretary not later than 25th September, and all Collections of Cones, Woods, and Geological Specimens not later than 25th October 1875—*each bearing a motto, and being accompanied by a separate sealed envelope bearing the same motto outside, and containing a card with the name and address of the Author.*

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Abstract of the Laws of the Scottish Arboricultural Society, as amended to November 1874.

I. The object of the Society shall be the promotion of the science of Arboriculture in all its branches, by periodical meetings of the Members for the reading of Papers; by offering Prizes for Essays and Reports on the Practical operations of Forestry, and publication of the same; and by such other means as may be found advisable.

II. The Society shall consist of the following classes of Members: —1. Proprietors, Factors, Nurserymen, and others, paying an annual subscription of Half-a-Guinea; 2. Head-Foresters, and others, paying an annual subscription of Five Shillings; 3. Assistant Foresters, and others paying an annual subscription of Three Shillings.

III. Any Member may become a Life Member by compounding for his annual subscriptions by a single payment—those of the First Class paying Five Guineas; and those of the Second and Third Classes, Three Guineas.

IV. The Society shall elect a limited number of Honorary Members, —gentlemen who have acquired eminence in the Science of Arboriculture, or who are otherwise deemed worthy.

V. All annual subscriptions shall be payable in advance, at the Annual General Meeting in November.

VI. In addition to the annual subscriptions above stipulated, the Society shall receive, from those friendly to its objects, Donations of larger or smaller amount.

VII. A Candidate for admission into the Society must be recommended by at least one Member, and shall, on payment of his annual subscription, be immediately admitted a Member of the Society, subject to the revision of the first General Meeting thereafter. Any Member of the Society introducing a New Member shall be held responsible for the first year's subscription of such party.

VIII. The affairs of the Society shall be conducted by a President, five Vice-Presidents, Secretary, Treasurer, Auditor, and fifteen Councillors—these office-bearers to be elected annually at the General Meeting in November; the three Councillors at the top of the list to go out annually, but one to be eligible for re-election.

IX. A General Meeting of the Members shall be held on the first Wednesday and Thursday of November annually, for the election of New Members, the appointment of Office-Bearers, awarding of Prizes, the reading of Papers, Discussion on selected subjects, &c.

JOHN SADLER,
Secretary.

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OFFICE-BEARERS FOR 1874-75.

PRESIDENT.

JOHN HUTTON BALFOUR, M.D., M.A., F.R.SS.L. and E., Professor of Botany in the University of Edinburgh.

VICE-PRESIDENTS.

The Right Hon. W. P. ADAM, of Blairadam, M.P.
HUGH CLEGHORN, M.D., F.R.S.E., of Stravithy, St Andrews.
WELLWOOD H. MAXWELL, of Munches, Dalbeattie.
ROBERT HUTCHISON, F.R.S.E., of Carlowrie, Kirkliston.
JOHN GRANT THOMSON, Wood Manager, Grantown.

COUNCIL.

JOHN M'LAREN, Forester, Hopetoun, South Queensferry.
HUGH FRASER, Stanwell Nursery, Edinburgh.
DAVID MITCHELL, Nurseryman, Edinburgh.
JOHN M'GREGOR, Forester, Ladywell, Dunkeld.
ALEXANDER RICHARDSON, Land Steward, Arniston, Gorebridge.
JAMES MOFFAT, Forester, Newbattle Abbey, Dalkeith.
JAMES SMITH, Forester, Donibristle, Fife.
WILLIAM M'CORQUODALE, Forester and General Wood Surveyor, Jeanie Bank, Perth.
WILLIAM THOMSON, Deputy-Surveyor, H.M. Chopwell Woods (*deceased*).
JOHN ALLAN, Forester, Dalmeny Park, Edinburgh.
JAMES MICHIE, Forester, Wemyss Castle, Kirkcaldy.
THOMAS METHVEN, Nursery and Seedsman, Edinburgh.
CHARLES S. FRANCE, Overseer, Penicuik House, Penicuik.
D. SCOTT, Wood Manager, Darnaway Castle, Forres.
JOHN ANDERSON, Nurseryman, Perth.

JUDGES.

WILLIAM GILCHRIST (Convener), Forester, Cluny Castle.
JOHN M'LAREN, Forester, Hopetoun, South Queensferry.
D. SCOTT, Wood Manager, Darnaway Castle, Forres.

COMMITTEE ON TRANSACTIONS.

The Secretary (J. SADLER), *Editor*.
Dr CLEGHORN, of Stravithy, St Andrews.
ROBERT HUTCHISON, of Carlowrie, Kirkliston.
WILLIAM GORRIE, of Rait Lodge, Edinburgh.

SECRETARY.

JOHN SADLER, F.R.Ph.S., Lecturer on Botany and Natural History in the Royal High School, and Assistant to the Professor of Botany in the University of Edinburgh.

TREASURER.

GEORGE CRICHTON (of Messrs G. & M. Crichton), 18 Princes Street, Edinburgh.

AUDITOR.

JOHN ORD MACKENZIE, W.S., of Dolphinton.

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